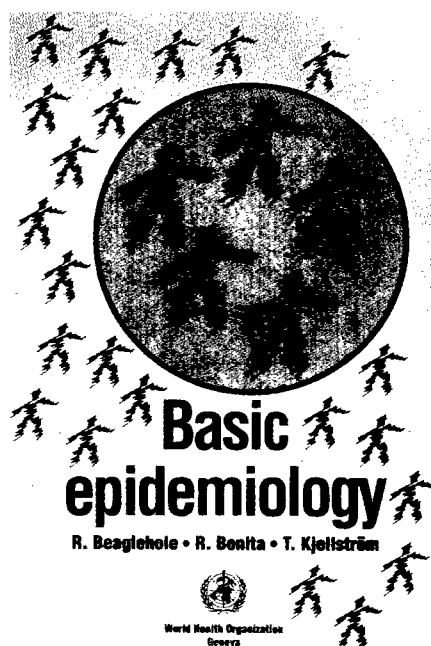


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TEACHER'S G U I D E

– 2nd edition –

F O R B A S I C E P I D E M I O L O G Y



World Health Organization
Geneva, 1994



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ORIGINAL: ENGLISH

TEACHER'S GUIDE

— 2nd edition —

BASIC EPIDEMIOLOGY

**R. Beaglehole¹, R. Bonita²
and T. Kjellström³**

The *Teacher's Guide for Basic Epidemiology* (2nd edition) is part of a series of materials produced by the World Health Organization to facilitate and strengthen teaching in epidemiology world-wide. A separate WHO publication, *Basic Epidemiology*, has been published as the corresponding student text. Chapters 1–6 of the *Guide* give practical advice on how to organize a course in basic epidemiology for health science students, medical students, or others needing a broad introduction to the subject, or for in-service training of environmental or occupational health professionals. Chapter 7 comprises a series of overheads and other resource materials. The course requires 20 to 40 hours of teaching, depending on the background of those taught.

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Preface

This *Teacher's Guide* is one of a series of teaching materials developed for the WHO Global Environmental Epidemiology Network (GEENET). It complements the student *Basic Epidemiology* text, published by WHO in 1993 and aims to facilitate use of that text for meeting a variety of teaching needs.

The members of the network have expressed great interest in this *Guide* and the additional planned teaching materials in epidemiology.

The *Guide* is designed for general introductory teaching. The *Basic Epidemiology* text is also suitable for more specialized introductory teaching, for example, as used in the WHO *Introduction to Environmental Epidemiology* workshops. A separate teacher's guide for these workshops is available from the Office of Global and Integrated Environmental Health, World Health Organization, 1211 Geneva 27, Switzerland.

Acknowledgements

This *Teacher's Guide* was developed with helpful input from numerous teachers of epidemiology, who also commented on the various drafts of *Basic Epidemiology*. In addition, these materials were formally evaluated by 12 members of 10 countries in 1990 and 1991; the authors gratefully acknowledge the help received from all colleagues who participated in this preparatory phase.

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1. Introduction

1.1 Purpose of the *Teacher's Guide*

The *Teacher's Guide* complements the student's *Basic Epidemiology* text and has two aims: to assist the teacher in the initiation, organization, delivery and evaluation of an introductory course in epidemiology for health science students; and to provide teaching resource material for the teacher, including definitions, tables and figures suitable for presentation as overhead transparencies, and examples of problem-solving exercises and examination questions.

The *Guide* has been prepared on the assumption that most teachers of epidemiology, indeed probably all teachers of health science students, are given little instruction on how to develop and teach a successful course. Most teachers learn by doing. In the long term this may lead to an exciting and well-received course, but in the short term, teachers and students alike will probably be frustrated and disappointed with the instruction given. Hopefully, the *Guide* will facilitate the transition from a new experimental course to a well-established excellent course. If you are already an experienced teacher with an up-to-date knowledge of effective teaching and learning methods, you are not likely to find much that is new to you in the first sections of this book, but we hope that the chapter resources will be of help.

The *Teacher's Guide* provides a general outline of how and what to teach. Inevitably the suggestions it contains will not be universally acceptable or appropriate. Customs and resources vary, and each course must be tailored to local circumstances.

1.2 How to use the *Teacher's Guide*

Basic Epidemiology is self-contained and can be used by students as a single resource book. The *Teacher's Guide* provides additional material, which should be used by the teacher to complement that of *Basic Epidemiology*. Sections 2 to 6 include information to assist the teacher with development of the epidemiology course.

The *Guide* should be read by the teacher well before the beginning of the course, to allow sufficient time for preparation of local examples to illustrate points discussed in the text. Material and ideas in this *Guide* will be of assistance not only to those teachers who are developing a new course but also to those who are responsible for established courses.

Later sections contain resource material which can be used to make overhead transparencies for group teaching. If an overhead projector is not available, this material can be copied onto a blackboard for illustration of the main points.

The *Guide* itself can be complemented by other more detailed and specialized books on epidemiology and teaching methods. A selection of these books is listed in Chapter 11 of *Basic Epidemiology*. Please note too that a detailed *Inventory of Basic Textbooks in Epidemiology, Occupational and Environmental Health*, together with their table of contents, has been published by the World Health Organization and is available on request from the Office of Global and Environmental Health (EHG), World Health Organization, 1211 Geneva 27, Switzerland.

2. Teaching Epidemiology: General Principles

2.1 Why teach epidemiology?

There is an increasing need to reorient health services away from expensive hospital-based care and towards prevention and health promotion. An epidemiological perspective is essential to this process. Furthermore, the evaluation of developments in clinical medicine requires the expertise of people with an epidemiological perspective; and of course, good clinical and public health practice itself requires a sound knowledge of epidemiology. Other justifications for teaching this subject can be found throughout *Basic Epidemiology*.

Epidemiology should therefore comprise an important component of the educational programme of all health professionals. In some centres, particularly in industrialized countries, epidemiology teaching is well-developed at both undergraduate and graduate level. ("Undergraduate level" is used here to refer to education at post high school, first degree level in a college or university, and "graduate level" to education above undergraduate level.) In many, if not most countries, epidemiology teaching is still at a regrettably early stage of development. The reasons for this are complex but include:

- the relatively low status accorded epidemiology in contrast to that enjoyed by the more glamorous medical specialities
- the world-wide shortage of epidemiologists, and,
- the well-known problems in changing curricula and freeing time for new courses.

But owing to the great variation in local circumstances, it is difficult to specify precisely the steps that should be taken when developing a new course in epidemiology. Several arguments will be useful though, whatever the local situation, when seeking to convince the appropriate local authorities (deans, sub-deans, chairs of curriculum committees, powerful clinicians, etc.) of the need for epidemiology courses. For example, as one of the basic sciences of prevention, epidemiology has much to contribute to the education of all health professionals, particularly if resources are in short supply. Moreover, an understanding of epidemiology is of great importance not only for those directly involved in the various health services, but also for those working in the many allied professions, be they sanitary engineers, environmental health scientists or occupational health engineers. It can therefore be readily argued that instruction in epidemiology should be made available in a variety of situations, and as part of established degree and other continuing education programmes.

2.2 Planning a course

The first step in developing a course in epidemiology is to draw up a clear statement of its aims and goals. These should be realistic. It is easy to draw up an ambitious and impractical proposal for a course which if accepted could consume the total working time of the available teaching staff. It is therefore more appropriate to start with a small and relatively unambitious teaching programme that will have a greater chance of success.

The proposal must also be realistic in terms of staff. It may be possible to include experts from outside the teaching institution who would welcome the opportunity to become involved with a teaching programme, if only on an "honorary" basis. Others, for example public health department staff or clinicians with an interest in clinical epidemiology, may also be happy to contribute to an epidemiology course at a university or technical institute, since to do so often confers additional status and can open up potential new areas of collaboration for research projects.

It is essential that one person, usually the course coordinator, takes responsibility for planning and development of the course, and that he or she is allowed sufficient time for these activities. The course coordinator's role is crucial and demanding and includes securing the necessary support, planning the course details, ensuring that the teachers are well-briefed, and that the necessary resources are available at the appropriate time.

The coordinator must also ensure that the epidemiology course is comprehensive and coherent, and that it occurs at an appropriate time within the student's overall learning programme. The timing of a new course will depend on local circumstances. In a traditional medical school, for example, this may be in the first or second year, before the students become distracted by the attractions of clinical medicine. On the other hand, the clinical years are the best time to teach clinical epidemiology since the students have daily contact with patients and are developing a knowledge of clinical epidemiology. Several new medical schools have an integrated approach to teaching and do not provide discrete courses. At these, epidemiology is introduced in a less direct manner, often as part of a broad problem-solving approach to learning. In such situations *Basic Epidemiology* and the *Teacher's Guide* can be used as resource material, rather than as the outline of a prescribed course.

When basic epidemiology is taught as a continuing education subject for public health workers or allied professionals, the timing of the course is less important than the motivation and prior experience of the students. Ideally, the students should have sufficient experience of public health work to be able to relate the teaching examples given in *Basic Epidemiology* to their own experiences and future work situations.

The course coordinator and other teachers contributing to the course should acquire appropriate teaching materials, problem-solving examples and other illustrations. *Basic Epidemiology* is intended to provide core information, while the *Guide* provides additional material in the chapter resource sections. Material from local sources should also be gathered to help the students recognize the value of epidemiology in their own environment.

2.3 What should students learn?

The course coordinator, in association with the other teachers, is responsible for course objectives and goals. It is essential that these are defined clearly; formal evaluation of the course will then be possible.

The objectives should be general statements about the overall purposes of the course, whereas the goals should be much more specific statements which cover the particular skills the students will be expected to acquire.

Objectives will vary, depending on the students taught, the timing and extent of the course, and the resources available. Proposed objectives and goals are given below. The objectives and goals should be discussed with the students at the beginning of the course.

Proposed objectives:

- to explain the principles of disease causation with particular emphasis on modifiable environmental factors
- to promote the application of epidemiology to the prevention of disease and the promotion of health, including environmental and occupational health
- to make members of the health-related professions aware of the increasing need for health services to address all aspects of the health of populations
- to encourage good clinical and public health practice
- to establish the basis of a continuing interest in epidemiology.

Proposed specific goals:

That by the end of the course the student will be able to demonstrate knowledge of:

- the nature and uses of epidemiology
- the epidemiological approach to defining and measuring the occurrence of health-related states in populations

- the strengths and limitations of epidemiological study designs
- the epidemiological approach to causation
- the contribution of epidemiology to the prevention of disease, the promotion of health and the development of health policy
- the role of epidemiology in evaluating the effectiveness and efficiency of health care and preventive health services
- the contribution of epidemiology to clinical practice including critical appraisal (particularly in respect to students working in clinical practice).

The students could also be expected to have gained a variety of skills during the course, and to have developed an ability to:

- describe the common causes of death and disability in their community
- outline the appropriate study design to answer specific questions concerning disease causation, natural history, prognosis, prevention, and the evaluation of therapy and preventive actions
- critically appraise reports and publications containing epidemiological data.

Learning objectives should also be developed for each teaching session or specific teaching component. We have prepared a short list of learning objectives for each chapter based on the structure of *Basic Epidemiology*. These are given as transparency masters (hereafter known as "overheads") in the chapter resources.

3. Teaching Epidemiology: Practical Aspects

Individual preferences and local conditions will have a direct bearing on how this introductory course in epidemiology is taught. Therefore, only the most general suggestions can usefully be made here.

The important first step is to define the objectives and goals of the course as discussed in Section 2.3. Once this has been done, the teaching methods should be tailored to meet these objectives.

3.1 The problem-solving approach to learning

The problem-solving approach to learning is based on the belief that learning is more effective and teaching more efficient if students have the opportunity to deal with real or simulated problems as part of their studies. Some of what you HEAR gets stored as a memory. If you SEE it, the memory becomes more vivid, even more so if you WRITE it down. But the strongest memory storage results from DOING. If the students apply epidemiological principles and analysis to their own public health or clinical tasks, and gentle supervision ensures that this is done correctly, the learning will be detailed and long-lasting.

The problems that the students deal with in a course setting should be of increasing complexity and the students should be encouraged to use appropriate resource materials. A first step in problem solving is to encourage students to answer questions based directly on material that has already been presented formally; for example, the questions in *Basic Epidemiology* can be introduced during a formal lecture and then discussed further in the student's own time, or in a tutorial or seminar with a small number of students. Additional questions based on local problems could also be introduced during the lectures.

The next level of problem solving should be taught during small group sessions. It involves developing a scenario, based on set exercises, and using structured questions to lead to a solution. At the most advanced level, students examine real public health or clinical problems, define the questions to be asked, seek the information required and find the solutions themselves, with guidance and assistance from the teacher as required.

3.2 Classroom teaching

Classroom teaching includes lectures, topic teaching, small group teaching, tutorials, panel discussions and symposia. The most common of these is the lecture, by means of which one person (the lecturer) can inform large numbers of students of the course objectives and the

principles and techniques of the subject. A lecture can also be used to introduce new ideas and new material—particularly information concerning the local and national situation—not readily available in text books. However, evaluations have shown that lecturing is not a very effective teaching method. Students have a limited attention span, perhaps as low as 20 minutes, so it can be difficult to maintain their interest. (It may therefore be appropriate to structure lectures in two 20-minute self-contained segments, with a brief interval between segments.)

However, since the teaching of epidemiology is usually undertaken by small and over-stretched departments, at least some parts of a course will probably have to be presented in lecture form. That said, a well-prepared and presented lecture can be an extremely satisfying experience and a very efficient means of teaching. Thorough preparation is essential and the lecturer must be confident in the subject, particularly if the opportunity is provided for questions during or at the end of the lecture.

Occasionally it may be useful to give a short epidemiology lecture as part of a more general course based around a particular topic. For example, if the topic is rheumatic heart disease, a short presentation on the epidemiology and prevention of rheumatic fever and rheumatic heart disease might be appropriate at the beginning of a session, followed by a description of the medical treatment, and then a description of the surgical treatment. The advantage of topic teaching is that the practical relevance of epidemiological data can be demonstrated easily. Systematic topic teaching programmes require careful organization and coordination in order to avoid duplication and omission. The principles and methods of epidemiology should be dealt with separately from the topic teaching, in order to allow the students time to absorb and practice the essential elements of epidemiology.

If the teaching resources are available, small group discussions can be an effective method of reinforcing understanding and practicing the application of the basic information presented in lectures. These sessions at undergraduate level are best led by the teacher, who should present the relevant material and then involve the students in a discussion of it. To be successful, all students should participate; it helps if written or tabulated material is handed out before the session. Small groups in particular offer good opportunities for practising the critical reading of published studies.

3.3 Teaching outside the classroom

Epidemiology teaching can take place in locations other than the classroom; for example, in a hospital, a health centre or the community.

Hospital-based teaching takes advantage of the student's interest in clinical medicine and is an ideal setting for illustrating the importance of clinical epidemiology. This type of teaching is best conducted by an epidemiologist with clinical experience and responsibilities, or by a clinician with a good understanding of epidemiological principles. It is also possible, but more difficult, for a non-clinical epidemiologist to be involved directly in bedside teaching.

Apart from being used as a base for the teaching of clinical epidemiology, the hospital setting can also be used to encourage students to study the epidemiology of the more common diseases seen in a hospital. Moreover, hospital epidemiology is itself a specialized topic that evidently can most easily be introduced in a hospital setting. Additionally, individual patient cases can serve as the basis of a discussion of the complex relationship between sickness, the community and its health services, and to raise issues concerning the effectiveness and efficiency of health services, and the potential benefits of disease prevention and health promotion. It can also be instructive to review the probable etiology of each patient's sickness (including reference to, for example, genetic factors, environmental factors, and occupational and life-style factors). This information about individual patients can be useful in teaching the etiological aspects of epidemiology.

In many parts of the world, medical and other health students contribute to the work of urban or rural health centres. These centres, especially if responsible for a well-defined population, provide a good opportunity for teaching epidemiology. Teaching based on the work of a health centre can ensure that students become aware of the full spectrum of disease that occurs in the community, rather than only that which is seen in its hospital(s). A community setting also enables students to understand the role of family, culture, and social and economic factors in the etiology of disease, and the importance of programmes aimed at preventing and controlling disease, and promoting health. Any epidemiological teaching that takes place at a health centre should be carried out by an epidemiologist with clinical responsibility, or by epidemiologically oriented primary health care staff. (This is because the major activities at a health centre focus on patients.) It may also be possible to involve students in epidemiological studies of community health problems, using the health centre as a base.

Community-based projects can be a useful means of involving students in the practice of epidemiology. Projects are particularly appropriate for advanced students who have the maturity and experience necessary for conducting independent work (under supervision). However, projects are demanding in terms of staff time and require active collaboration from people and agencies outside the teaching institution. Ideally, projects should be based on a real problem—identified by a client—in the community. Projects should not be too ambitious as the time available is often limited and the skills of the students are still in the process of

developing. The stages that should be followed when undertaking a practical project are discussed in Chapter 11 of *Basic Epidemiology*.

Another advantage of projects is that students must work cooperatively as a team. Furthermore, successful projects give students a sense of having made a worthwhile contribution. And clients are often grateful for even the most basic information since this is usually more than would otherwise have been available to them. At the end of the project the students should complete a written report, and if appropriate, make a verbal presentation of their findings to the class and the clients. Occasionally, project descriptions and findings can be published in a local health journal under the guidance of the supervising staff member. Suitable topics for projects will depend entirely on the local situation and may cover the entire field of epidemiology, from disease causation through to health services management. Projects may be based in a community, occupational, or hospital setting.

3.4 Timetabling

Basic Epidemiology is designed for use in an introductory course which is allocated approximately 20 to 40 hours of formal teaching, comprising a mixture of one-hour lectures and several longer periods for small group work. Traditionally, lectures are used to present basic material, while seminars provide an opportunity for students to work on specific problems and exercises. Advanced students might also have time to work under supervision on a project which applies the principles of epidemiology and other allied disciplines in a real world setting.

Only rarely will it be possible to timetable a new course within a formal degree programme in an ideal manner. Usually the course must be slotted into the allocated time periods. Large class size, combined with a small number of teachers, is another common constraint. Within a degree programme, the best option may be to schedule two three-hour blocks each week for a five- to six-week period. The topics for these sessions could coincide with the titles of the 11 chapters of *Basic Epidemiology*, amended according to local needs. Spreading the course in this way allows students time to read the text and complete the exercises.

If organized as a separate continuing education course, it may be more convenient, or necessary, to hold the course full-time during one week:

- **Day 1:** introduction to the subject, to definitions of epidemiology and the measurement methods it uses

- **Day 2:** study design and statistical issues
- **Day 3:** causation and prevention
- **Day 4:** communicable diseases and clinical epidemiology
- **Day 5:** aspects of environmental/occupational epidemiology and health services
- **Day 6:** encouraging the students to continue their study of epidemiology.

The specific context of the teaching could be modified to suit the needs of a particular target group. For instance, WHO has developed a "standard" one week course (*Introduction to Environmental Epidemiology*) using the *Basic Epidemiology* text, but adding material on environmental health. (For further information contact Dr. T. Kjellström, Office of Global and Integrated Environmental Health (EHG), World Health Organization, 1211 Geneva 27, Switzerland.)

A continuing education course in basic epidemiology could also be stretched out over time, with sessions held once or twice a week, if the students and teachers are available for teaching in this manner. In such cases, a problem-solving approach to learning is helpful since the students have time between sessions to put their new knowledge and skills to the test in real work situations.

If a course is held full-time over a week it is of great benefit to assign individual problem-solving tasks to the students some time during the one to three months following the course, with the request that they report upon and discuss these at a follow-up session.

3.5 Audiovisual teaching aids and other resources

Well-prepared teaching aids can be of great assistance in all teaching situations. Conversely, poorly prepared material can be counter-productive. Teaching aids for presenting information should attract attention and be relevant to the matters being discussed. Use of them must be planned carefully. Ideally, they should be prepared in advance and for a specific teaching session.

The most basic teaching aid is the chalk board but it should be used discriminately. Writing must be legible from the back of the room and the teacher should not face the board while

talking. There are variations on the chalk board; for example, boards for use in conjunction with felt-tip pens, and paper flip-charts. They are all useful for displaying information and all must be used with care.

Overhead projectors enable material written on or copied onto plastic film to be projected onto a screen, and can be used for presenting prepared material to a class and/or to summarize material as a session proceeds. The plastic films used are commonly known as transparencies; many photocopying machines can copy directly onto these. We have included a number of illustrations and tables in the chapter resources that could be produced as overheads in this way. When using an overhead projector, the teacher can continue to face the class at all times. A bright projector that does not require a darkened room is best. Overhead projectors are readily portable and not as expensive as slide projectors.

We have included a number of illustrations and tables in the chapter resources that could be produced as slides. Slide projectors can be either helpful or unhelpful. They require a darkened room and may therefore distract students from the verbal presentation. It is perhaps surprising how often projectors do not function properly. Unsurprisingly, they require a reliable source of electricity and regular maintenance. As for the slides themselves, they often contain too much material and are unnecessarily complicated. But well-prepared slides can help stimulate interest and discussion, particularly if the students are asked to describe and interpret the data presented.

In some situations video-taped material may also prove to be a good means of presenting information to encourage discussion. But the necessary equipment is expensive and requires professional maintenance. Furthermore, producing video teaching material is time-consuming and difficult. The effort may be justified though if field situations have to be presented in a classroom setting. The World Health Organization has prepared an inventory of available teaching videos and documentaries on environmental and occupational health. (The inventory is available from the Division of Global and Integrated Environmental Health (EHG), World Health Organization, 1211 Geneva 27, Switzerland). (See also Table 1.) Some of these can be used to demonstrate epidemiological applications in field work. Videos recorded from TV documentaries on public health issues may occasionally be suitable for teaching, and if equipment is available, recording of local programmes may also be very useful.

It should be remembered too that there already exists a great deal of material which could be used in designing and conducting a course in epidemiology. Some of this is readily available at either no or low cost. For instance, those books and reports listed in Table 1 which have been produced by the World Health Organization and the International Epidemiological Association would be of great assistance in preparing a course.

Additionally, a great deal has been written on the philosophy and practice of teaching in general, and on medical education in particular.

Table 1. Resources for Teachers

ABBATT FR. *Teaching for better learning: a guide for teachers of primary health care staff*. 2nd ed. Geneva, World Health Organization, 1992.

LAST JM. *A dictionary of epidemiology*. 2nd ed. New York, Oxford, Toronto, Oxford University Press, 1988.

LOWE CR & KOSTRZEWSKI J, eds. *Epidemiology: A guide to teaching methods*. Edinburgh, Churchill Livingstone, 1973.

LLWANGA SK & CHO-YOOK T. *Teaching health statistics: twenty lessons and seminar outlines*. Geneva, World Health Organization, 1986.

OLSEN J & TRICHOPOULOS D, eds. *Teaching epidemiology: what you should know and what you could do*. Oxford, New York, Toronto, Oxford University Press, 1992.

ROTEM A & ABBATT FR. *Self-assessment for teachers of health workers: How to be a better teacher*. Geneva, World Health Organization, 1982 (WHO Offset Publication No. 68).

Teaching materials for the Global Environmental Epidemiology Network. Available on request from the Office of Global and Integrated Environmental Health (EHG), World Health Organization, 1211 Geneva 27, Switzerland.

As for material for illustrating local problems, this can often be found in national publications, especially those produced by health departments or national statistics centres. Similarly, national and international medical journals can be scanned for examples for use in either large or small group sessions.

4. Problem Solving in Epidemiology

4.1 Use of problem-solving exercises

Given the nature of epidemiology, active involvement in epidemiological exercises is often not feasible for undergraduates. However, problem-solving exercises can provide a practical substitute. Epidemiology can be taught using exercises based on data from completed epidemiological studies which may cover a specific disease or method, or a combination of issues. For undergraduates, the best problem-solving exercises involve little or no calculation and resemble a guided small discussion group.

Many problem-solving exercises have been prepared for epidemiological teaching. Some of these are suitable for use in an introductory course. Examples are to be found in the International Epidemiological Association books listed in Table 1. Others are available from Epidemiologic Intelligence Services (EIS) at the Center for Disease Control, Atlanta, USA. They may be universally applicable, or require modification.

4.2 Developing new examples

However, teachers are encouraged to develop their own problem-solving exercises. These should be interesting, based on real data, and relevant to the problems students will encounter in real life. The problems should be presented in a stepwise manner, and the students should be asked to comment on tabular material and suggest study designs which could be used in further investigations. Whenever possible, problems should be based on data which are recognizably local, although often this will require adapting exercises prepared by other teaching centres. Two examples of approaches to problem-based learning are included in the chapter resources (see Sections 7.5 and 7.7). Additional examples have been prepared for the WHO Global Environmental Epidemiology Network (GEENET) and are available from the Office of Global and Integrated Environmental Health (EHG), World Health Organization, 1211 Geneva 27, Switzerland.

5. Self-assessment for Teachers

Good lecturers are usually made rather than born, and the skills involved in creating and presenting a good lecture, or in giving a good tutorial, require practice and guidance. Even if you have been teaching for many years, you may find it useful to now and again take a critical look at the way in which you teach and how your students perceive your teaching methods. Some handy hints are given here.

A thorough knowledge of the subject matter is of course important, but the students should not expect you to produce answers immediately to all their questions. Epidemiology is a very broad subject and it shows good judgement to defer answers to certain questions until you have had an opportunity to check with the relevant literature.

Some aspects of teaching, such as the need for audibility and visibility, are self-evident. Similarly, it is obvious that teachers should face their audience and use good teaching aids. A sense of timing and humour and an ability to relate to students can also contribute to developing a good relationship with the class. And it is important to be able to exert control over those students who may prefer to be elsewhere, or who are unwilling to listen.

All new (and many experienced) teachers need help with the development and presentation of their lecture material. Some teaching institutions now have staff who specialize in teaching teachers and their help should be enlisted earlier rather than later. In the absence of a teaching unit, senior colleagues should be asked for help and advice; most teachers have learnt through experience and are prepared to assist younger colleagues.

A WHO booklet—*Self-assessment for Teachers of Health* by Rotem & Abbatt—is an excellent source of advice, whatever stage a teacher has reached in his or her career. It illustrates the teaching skills that can be developed and indicates ways of improving these skills.

Evaluation of the course and the teachers by the students is as important as examination of the students. This evaluation should cover course content, the course's relevance to and interest for the students, and the teaching methods and teaching aids employed. The opinions of the students will help the teachers to modify the course. Formal evaluation should be carried out at the end of the course, usually by means of a written and anonymous response from each student. Time should be allowed for this during the class. Students should be asked for both positive and negative feedback and for constructive suggestions as to how the course might be improved. Teachers should remember that it is impossible to meet the needs of all students; students' comments may even be contradictory.

The results of systematic evaluation of a small number of undergraduate courses in epidemiology have been published. These courses have in general been shown to be highly successful (Table 2).

Table 2. Some evaluated epidemiology courses

HELLER RF & PEACH H. Evaluation of a new course to teach the principles and clinical applications of epidemiology. *International Journal of Epidemiology*, 1987, 13:533-537.

FOWKES FGR et al. Epidemiology for medical students: A course relevant to clinical practice. *International Journal of Epidemiology*, 1984, 13:538-541.

ELWOOD JM et al. Research in epidemiology and community health in the medical curriculum: students' opinions of the Nottingham experience. *Journal of Epidemiology and Community Health*, 1986, 40:232-235.

6. Student Evaluation and Examination

6.1 Purpose of evaluation

Evaluation of a course in epidemiology has several objectives:

- to assess the performance of the students in relation to the course objectives
- to assess the effectiveness of the teacher
- to provide feedback for modification of the course.

6.2 Approaches to evaluation

In many teaching situations, students are assessed by means of term and end-of-year examinations, and these, rather than wider educational reasons, may become the students' incentive for studying. The evaluation process can, however, also serve as an educational strategy in its own right.

Evaluation should be a continuous process, designed to identify early on those students who are experiencing difficulty. Time should be allowed for informal evaluation at the end of each session. This provides an opportunity for students to ask questions and to identify areas of difficulty which can be addressed either immediately or in the next teaching session.

Throughout the course, homework assignments on specific topics can be used to provide feedback on the students' progress, as well as to give them the chance to practice dealing with the types of questions that will occur in the final examination. It is important that assignments and examination questions are consistent with the teaching objectives and methods. For example, if a problem-solving approach to teaching has been used in the course, the same approach should be used in assignments and examinations.

6.3 Examinations

The most commonly used assessment procedure is a written examination which may include essay, short-answer or multiple-choice questions. But whatever type of examination is favoured, it is important that the questions are presented in a straightforward and realistic manner and that they are tailored to the time available. Proposed questions should be discussed with colleagues to ensure their suitability.

Multiple-choice questions are often not appropriate in epidemiology because simple answers cannot always be specified and it is difficult to build up a large bank of suitable questions. Short answer questions are easier to formulate than essay questions and easier to mark objectively; they can test knowledge over a wide range of material.

For written examinations, the method of marking should be specified clearly. Model answers, prepared before the examination, should be available to the students after the examinations. Because marking can be subjective, at least some of the questions should be marked by more than one teacher in order to check for observer bias.

Oral examinations can be useful, particularly for students who are on the borderline. However, although this type of examination can cover a large number of areas rapidly, several examiners may be required at any one time and marking is difficult. Furthermore, an oral examination can be a very stressful event for a student.

7. Chapter Resources

This section of the *Teacher's Guide* provides a variety of resource materials which will be useful when running a basic epidemiology course. These include:

- background material
- suggested questions for use in tutorials or seminars to stimulate discussion
- additional references
- materials suitable for use as handouts after photocopying
- overhead explanations, tables and figures that can be transferred to overhead transparencies (including all the tables and figures found in the student text).

The materials have a slightly different emphasis for each chapter in order to encourage teachers to provide their own teaching aids. As a general rule, handouts are for students and overheads for the teacher (for use as a basis of discussion when working through *Basic Epidemiology*). Handouts can of course be converted into overheads as appropriate, and vice versa. The overheads can also be copied to a chalk board if required. The resource materials should be considered as examples; they are unlikely to completely meet all the teaching needs arising in relation to each chapter.

Each chapter resource section includes a list of the resources pertaining to the chapter in question, together with a copy of each resource mentioned. Tables and figures are listed in the order in which they appear in *Basic Epidemiology*. The full references for sources used can be found in the References section of *Basic Epidemiology*. (The overhead explanations comprise new material not found in *Basic Epidemiology*.)

7.1 Chapter 1 resources

Learning objectives overhead

Overhead explanations

Overhead 1.1	Definition of epidemiology
Overhead 1.2	The relationship between epidemiology and clinical medicine

Overhead tables and figures from *Basic Epidemiology*

Table 1.1	Deaths from cholera in districts of London supplied by two water companies, 8 July to 26 August 1854
Figure 1.1	Death rates from lung cancer (per 1000) by number of cigarettes smoked, British doctors, 1951–1961
Figure 1.2	Uses of epidemiology
Figure 1.3	Number of countries with smallpox, 1967–1978
Figure 1.4	Reported rheumatic fever occurrence in Denmark, 1862–1962
Table 1.2	Proportion of US white males aged 65–74 years with raised blood pressure according to criteria for hypertension
Table 1.3	Age-standardized lung cancer death rates (per 100 000 population) in relation to cigarette smoking and occupational exposure to asbestos dust
Figure 1.5	AIDS: the hidden epidemic

Handout

Handout 1.1	Further questions for discussion of issues in Chapter 1
-------------	---

Learning Objectives: Chapter 1

- 1. Place epidemiology in an historical context.**
- 2. Define epidemiology and outline its scope.**
- 3. Describe some of the contributions of epidemiology to the improvement of the health status of populations.**



Overhead 1.1

DEFINITION OF EPIDEMIOLOGY

"Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations and the application of this study to the control of health problems."

(Last, 1988)



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Overhead 1.2

THE RELATIONSHIP BETWEEN EPIDEMIOLOGY + CLINICAL MEDICINE



Populations

- Studies/Assessments
- Prevention
- Evaluation
- Planning

Individuals

- Diagnosis
- Treatment
- Curing
- Caring



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Table 1.1

**Deaths from cholera in districts of London
supplied by two water companies
8 July to 26 August 1854**

Water supply company	Population 1851	No. of deaths from cholera	Cholera death rate per 1000 population
Southwark	167 654	844	5.0
Lambeth	19 133	18	0.9



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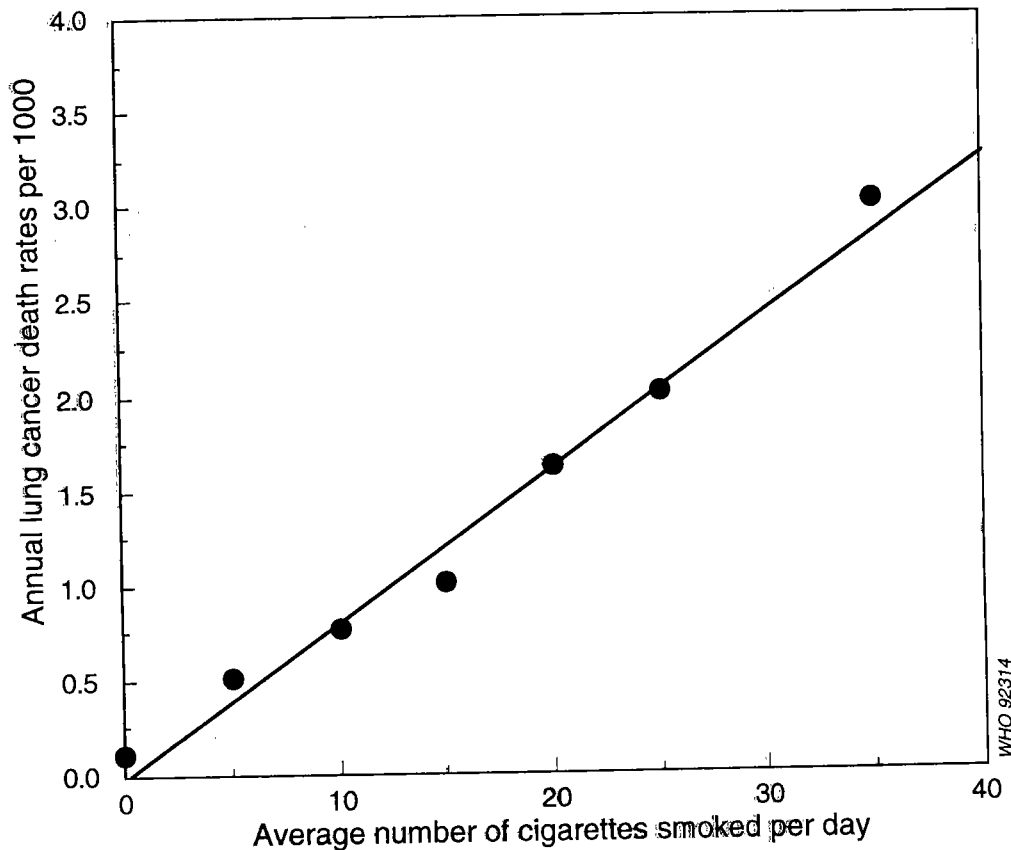
Source: Snow, 1855.

page 28

Summary of John Snow's analysis of cholera mortality in London in 1854. It shows how the calculation of mortality rates for individual London districts highlighted the much higher rate in the population served by the Southwark water company. Snow could make such calculations because drinking water was provided by a number of separate companies in different parts of London. If everybody in the population had received water from the same source, this type of analysis would not have been possible.

Figure 1.1

Death rates from lung cancer (per 1000) by number of cigarettes smoked, British doctors, 1951–1961



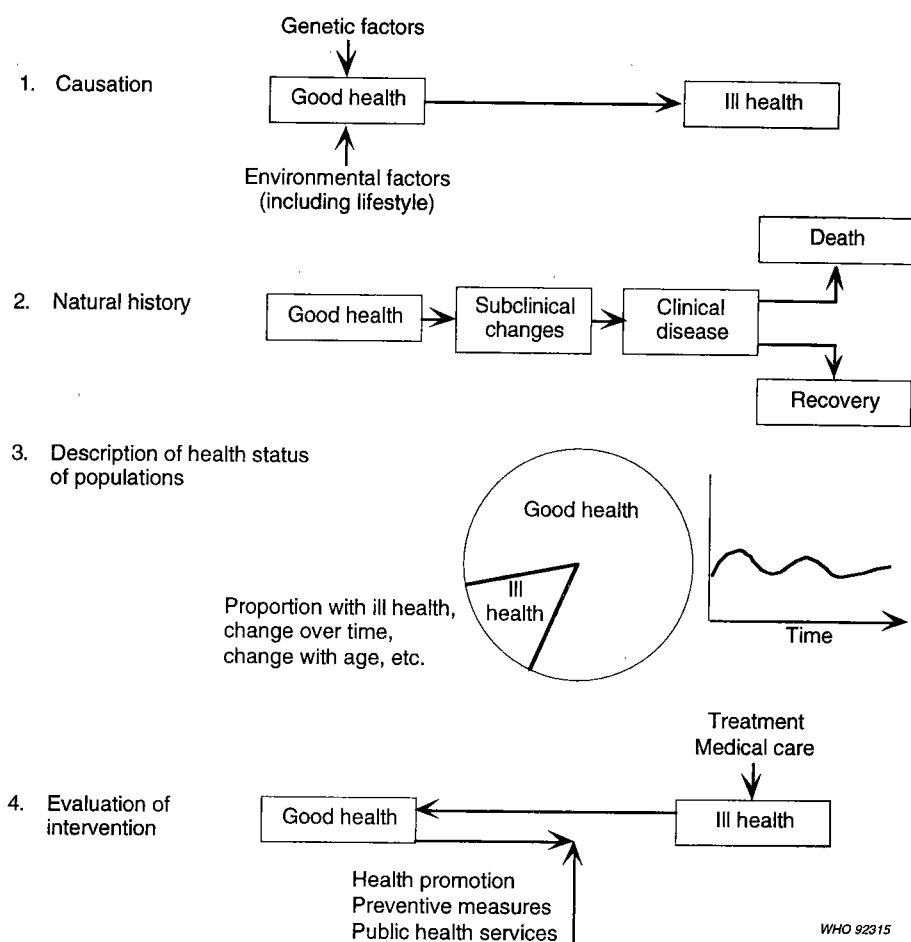
WORLD HEALTH ORGANIZATION

Source: Doll & Hill, 1964. Reproduced by kind permission of the publisher.

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The pioneering work of Doll and Hill in the 1960s demonstrated a correlation between lung cancer mortality and tobacco smoking. The figure shows that lung cancer mortality rates among British doctors rise when the number of cigarettes they smoke per day increases. This is called a dose-response relationship and in this case it is linear. The lung cancer death rate among non-smoking doctors is about 0.1 per 1000 doctors. But if a doctor smokes 10 cigarettes a day it rises to about 0.8, and to 1.5 if he or she smokes 20 cigarettes a day, and so on.

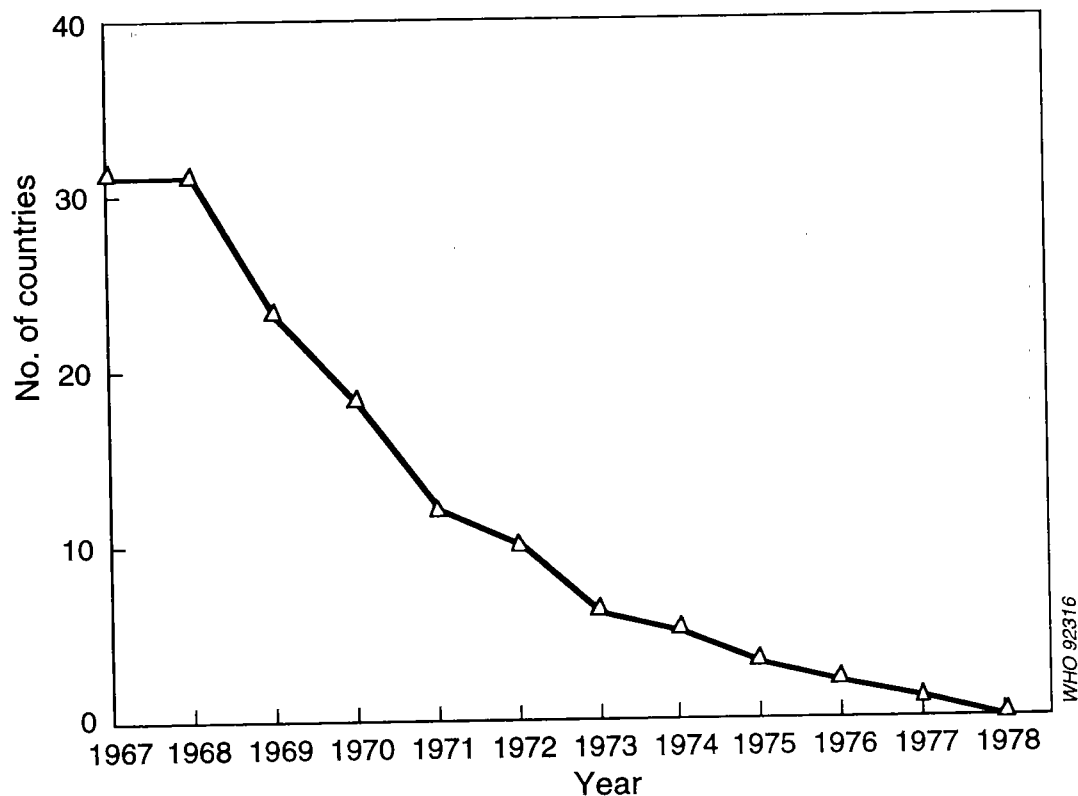
Figure 1.2
Uses of epidemiology



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Epidemiology can be used to establish **CAUSATION** (e.g. how genetic and environmental factors adversely affect people in good health); and the **NATURAL HISTORY** of a disease (increase in severity of change in bodily functions until clinical disease has developed, or recovery due to natural healing or as a result of treatment). Epidemiology can also be used to **DESCRIBE** the health status of a population in relation to time, geographic areas etc., and to **EVALUATE** the impact of interventions to prevent disease or injury in a population or the impact of treatment on groups of patients.

Figure 1.3
Number of countries with smallpox, 1967-1978



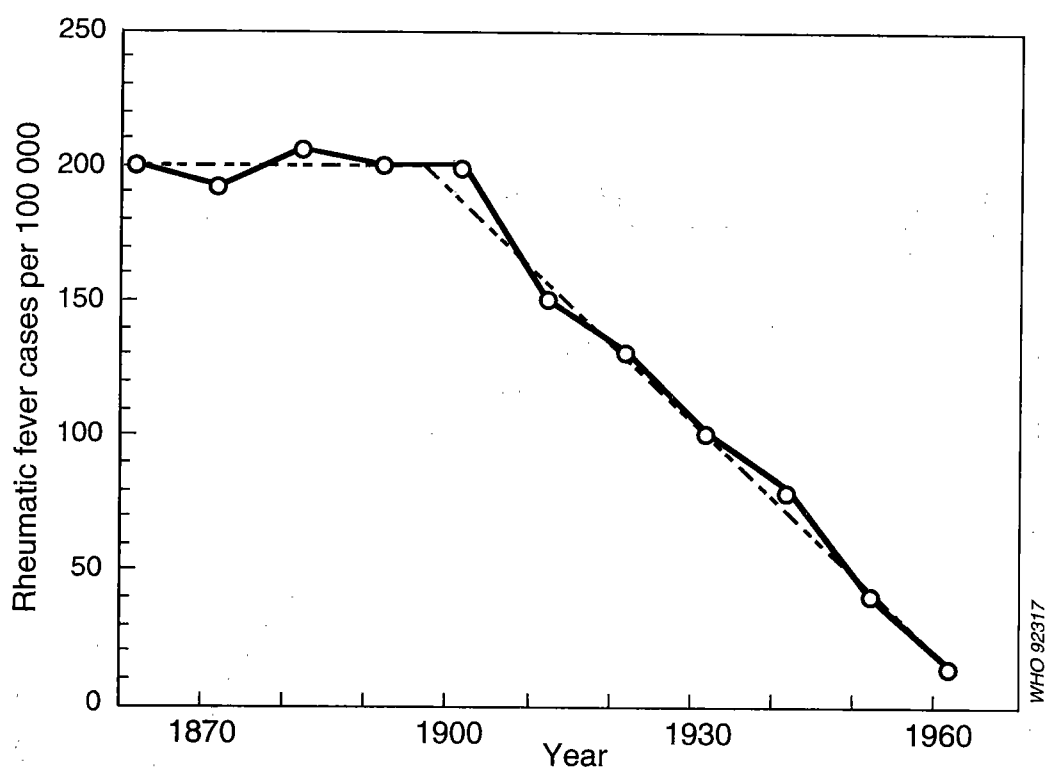
WORLD HEALTH ORGANIZATION

Source: Fenner et al., 1988.

page 31

An example of simple descriptive epidemiology, which shows the progressive success of the global campaign coordinated by WHO to eradicate smallpox. Within each country more detailed time trends and geographic distribution studies were used to identify requirements for further immunization and other actions.

Figure 1.4
Reported rheumatic fever occurrence in Denmark, 1862-1962



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Source: Taranta & Markowitz, 1989. Reproduced by kind permission of the publisher.

page 32

An example of simple descriptive epidemiology within one country. Incidence rates have been calculated so that a proper time trend analysis can be carried out. The rates started to decrease at the beginning of the 20th Century, long before effective drug treatment was available. Improved environmental conditions, such as better housing and less crowding, probably explain the initial decline in the occurrence of rheumatic fever in Denmark.

Table 1.2

**Proportion of US white males aged 65–74 years with
raised blood pressure according to criteria
for hypertension**

Blood pressure (systolic/diastolic) (mm Hg)^a	Percentage of population
$\geq 140/90$	53
$\geq 160/95$	24
$\geq 170/95$	17

^a One or both of systolic and diastolic pressures.



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Source: Drizd et al., 1986.

page 33

These descriptive data on prevalence of hypertension among a specific age group in the United States show that prevalence differs according to the "operational definition", i.e. the cut-off point for "high" blood pressure. If a "strict" definition of hypertension is used, so that only those with pressure above 170/95 are declared "hypertensive", the prevalence is 17%. If a "broader" definition with a cut-off point at 140/90 is used, the prevalence is 53%. When examining epidemiological data, close attention should be paid to the definition of "ill health" that is used.

Table 1.3

**Age-standardized lung cancer death rates
(per 100 000 population) in relation to cigarette
smoking and occupational exposure to
asbestos dust**

Exposure to asbestos	History of cigarette smoking	Lung cancer death rate per 100 000
No	No	11
Yes	No	58
No	Yes	123
Yes	Yes	602



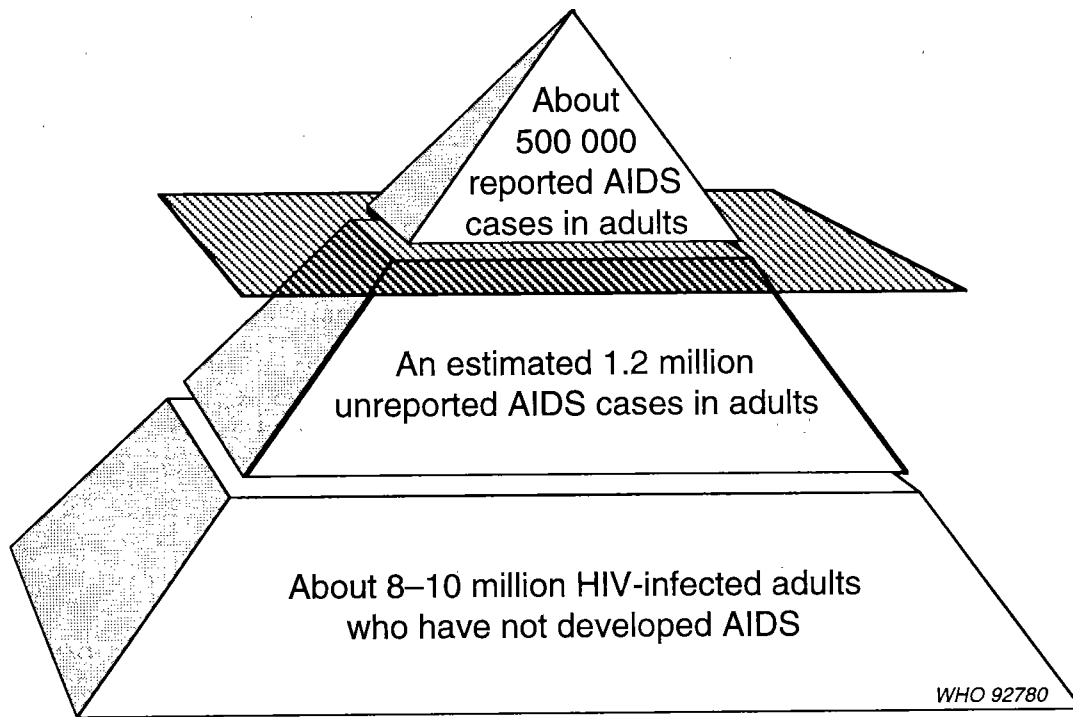
WORLD HEALTH ORGANIZATION

Source: Hammond et al., 1979.

page 34

The table shows that rates can be calculated to highlight the impact of two different environmental factors on the occurrence of one disease, in this case lung cancer. Asbestos exposure increases the lung cancer rate by about 5 times, while cigarette smoking exposure increases it by about 10 times. Combined exposure increases the rate more than 50 times. Thus the impact of combined exposure on lung cancer rate is obtained by multiplying the impact of the two individual measures. For other diseases, though, the impacts of causative factors are additive, while for yet others they are independent of each other.

Figure 1.5
AIDS: the hidden epidemic



Figures and estimates as of mid-1992.



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This figure highlights the problem of relying on descriptive epidemiological data based on the reporting of AIDS cases by health services. Many cases are either not diagnosed properly or not reported at all. In addition, the large number of people with HIV infection will contribute an increasing number of AIDS cases. Epidemiological studies can help establish the burden of AIDS and HIV on the community more accurately than some of the reporting systems currently in use.

Handout 1.1

FURTHER QUESTIONS FOR DISCUSSION OF ISSUES IN CHAPTER 1

Rheumatic heart disease

1. Is rheumatic heart disease a common condition in your country?
2. How is it distributed in the community?
3. What control measures are available and currently in use?

High blood pressure

4. Is the prevalence of hypertension known in your country?
5. What methods are available for its prevention and control?
6. Starting at what blood pressure level is treatment recommended? What implications does this have in terms of cost?
7. Discuss the role of a non-pharmacological approach to managing mild hypertension.

AIDS

8. Is there an official notification system for AIDS in your country?
9. How many cases of AIDS have occurred and how many people have been shown to be exposed to the human immunodeficiency virus?
10. What methods are available for monitoring the development of the epidemic?
11. What preventive programmes are applicable to your country? How might they be evaluated?

7.2 Chapter 2 resources

Learning objectives overhead

Overhead explanations

Overhead 2.1	Measuring health and disease
Overhead 2.2	What is health?
Overhead 2.3	Definitions of health and disease require definitions of normality
Overhead 2.4	WHO case-definition for AIDS
Overhead 2.5	Measurement of health and disease is required for
Overhead 2.6	Routine information
Overhead 2.7	Prevalence rate
Overhead 2.8	Incidence rate
Overhead 2.9	Life expectancy
Overhead 2.10	Infant mortality rates

Overhead tables and figures from *Basic Epidemiology*

Table 2.1	The Jones criteria (revised) for guidance in the diagnosis of acute rheumatic fever
Figure 2.1	Population at risk in a study of carcinoma of the cervix
Figure 2.2	Factors influencing observed prevalence rate
Table 2.2	Prevalence rate of non-insulin-dependent diabetes mellitus in selected populations
Table 2.3	Relationship between cigarette smoking and incidence rate of stroke in a cohort of 118 539 women
Figure 2.3	Example of calculation of disease occurrence
Table 2.4	Infant mortality rates in selected countries, 1987
Table 2.5	Life expectancy (years) at selected ages for four countries
Table 2.6	Crude and age-standardized mortality rates (per 100 000) for diseases of the circulatory system in selected countries, 1980
Table 2.7	Age-standardized mortality rates (per 100 000) in the 30–69-year age group, for coronary heart disease and stroke

Table 2.8 Hospital admission rates for asthma per 100 000 by age
(Auckland, New Zealand)

Handouts and teacher's notes

Handout 2.1	Comparisons of crude, specific, and adjusted rates
Teacher's notes 2.1	Routinely available information (census)
Handout 2.2	Summary: incidence and prevalence measures
Teacher's notes 2.2	Incidence and prevalence

Learning Objectives: Chapter 2

- 1. Describe criteria and measures of disease occurrence commonly used in epidemiology.**
- 2. Understand the use to which routinely available data can be put in epidemiology.**
- 3. Appreciate the differing approaches used in epidemiology to compare the occurrence of disease.**



Overhead 2.1

MEASURING HEALTH AND DISEASE

- 1. Definitions**
- 2. Measurement (general issues)**
- 3. Routinely available information
(e.g. mortality, morbidity)**
- 4. Measures of disease frequency**
- 5. Measures of effect**



Overhead 2.2

WHAT IS HEALTH?

**"Health is a state of
complete physical, mental and
social well-being and not
merely the absence of
disease or infirmity."**

(WHO, 1948)



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Overhead 2.3

DEFINITIONS OF HEALTH AND DISEASE REQUIRE DEFINITIONS OF NORMALITY:

- **Common (frequent)**
- **Statistical (within a range)**
- **Pragmatic (related to risks)**
- **Practical (related to benefits)**

DEFINITIONS ARE BASED ON:

- **Signs**
- **Symptoms**
- **Results of tests**



Overhead 2.4

WHO CASE-DEFINITION FOR AIDS

The presence of disseminated Kaposi sarcoma
or cryptococcal meningitis

OR

Two major signs in association with at least one minor sign:

MAJOR SIGNS

Weight loss > 10%

Fever > 1 month

Chronic diarrhoea > 1 month

MINOR SIGNS

Persistent cough > 1 month

General pruritic dermatitis

Recurrent herpes zoster

General lymphadenopathy

Chronic herpes simplex

Oral candidiasis

Source: *Weekly Epidemiological Record*, 1986, 61: 61-76.



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Overhead 2.5

**MEASUREMENT OF HEALTH AND
DISEASE IS REQUIRED FOR:**

- Preventing disease
- Promoting health
- Planning health services

**THE CENTRAL TOOL OF EPIDEMIOLOGY
IS THE COMPARISON OF RATES:**

$$\text{Rate} = \frac{\text{Numerator}}{\text{Denominator}}$$



WORLD HEALTH ORGANIZATION

Overhead 2.6

ROUTINE INFORMATION

MORTALITY (DEATH) DATA:
(coded according to the ICD)

CRUDE MORTALITY RATE (CMR):

$$\text{CMR} = \frac{\text{Total \# people dying}}{\text{Total \# people}}$$

AGE-SPECIFIC RATES

SEX-SPECIFIC RATES

CAUSE-SPECIFIC RATES

AGE-STANDARDIZED RATES
(also called age-adjusted rates)



WORLD HEALTH ORGANIZATION

Overhead 2.7

PREVALENCE RATE IS DEFINED AS:

The proportion of the population at risk affected by a disease at a specific point in time.

PREVALENCE RATE (P) IS CALCULATED BY:

$$P = \frac{\text{Number of people with the disease or condition at a specific time}}{\text{Number of people in the population at the specified time}} \times 10^n$$



WORLD HEALTH ORGANIZATION

Overhead 2.8

INCIDENCE RATE (I) MEASURES:

The rate at which new events occur in a population.

INCIDENCE RATE IS CALCULATED BY:

$$I = \frac{\text{Number of persons who contract the disease in a specified period}}{\text{Sum of the length of time each person in the population is at risk of contracting the disease}} \times 10^n$$

CUMULATIVE INCIDENCE:

Is a simpler measure of the occurrence of a disease or new health status.

Unlike incidence rate, it measures the denominator at only one point in time.



WORLD HEALTH ORGANIZATION

Overhead 2.9

LIFE EXPECTANCY

Average number of years of life remaining at specified ages if current mortality trends continue.

EXAMPLE: New Zealand life expectancy at birth (years)

	Men	Women
European	71	77
Maori	67	71



WORLD HEALTH ORGANIZATION

Overhead 2.10

INFANT MORTALITY RATES (IMR)

$$\text{IMR} = \frac{\text{\# of deaths in a year of children less than 1 year of age}}{\text{\# of live births in the same year}}$$

PERINATAL MORTALITY	28 wks gestation → 1 wk of life
NEONATAL MORTALITY	1st month of life
POST NEONATAL MORTALITY	1 month → 1 year

(Also refer to *Teaching Health Statistics*, pp.109, 128.)



WORLD HEALTH ORGANIZATION

Table 2.1

The Jones criteria (revised) for guidance in the diagnosis of acute rheumatic fever

A high probability of rheumatic fever is indicated by the presence of two major, or one major and two minor, manifestations, if supported by evidence of a preceding Group A streptococcal infection.

Major manifestations

Carditis
Polyarthritits
Chorea
Erythema marginatum
Subcutaneous nodules

Minor manifestations

Clinical:

fever
arthralgia (joint pains)
previous rheumatic fever or
rheumatic heart disease

Laboratory:

acute-phase reactants:
abnormal erythrocyte
sedimentation rate,
C-reactive protein,
leukocytosis
prolonged P-R interval



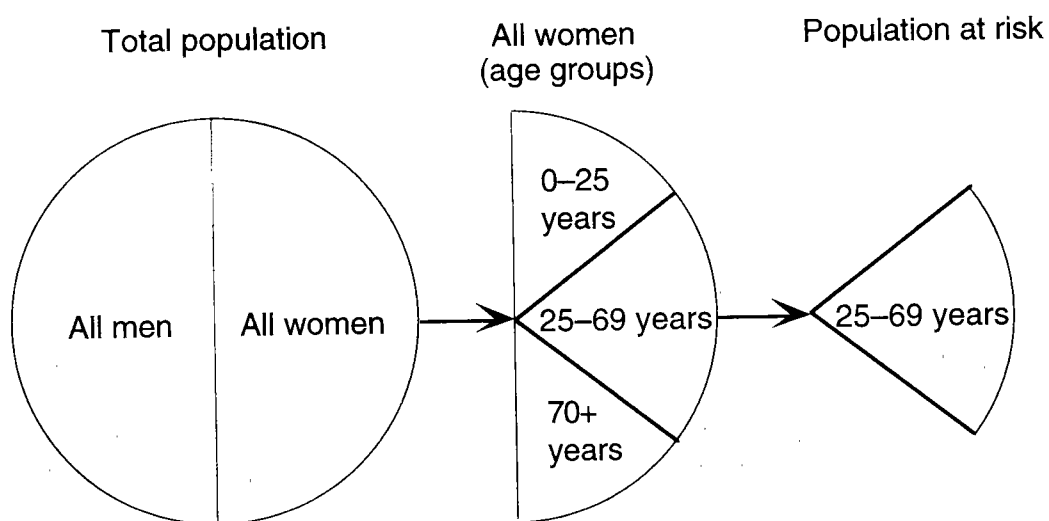
WORLD HEALTH ORGANIZATION

Source: WHO, 1988a.

page 50

For any epidemiological study, a clear definition of what will be classified as a case of "ill health" is crucial. If studies of rheumatic fever use this case definition, prevalence measurements in different studies can be compared properly. For many common diseases (e.g. asthma) the case definitions used in different countries or by different doctors vary, with the result that some geographical comparisons or time trends based on routine data are very misleading.

Figure 2.1
Population at risk in a study of
carcinoma of the cervix



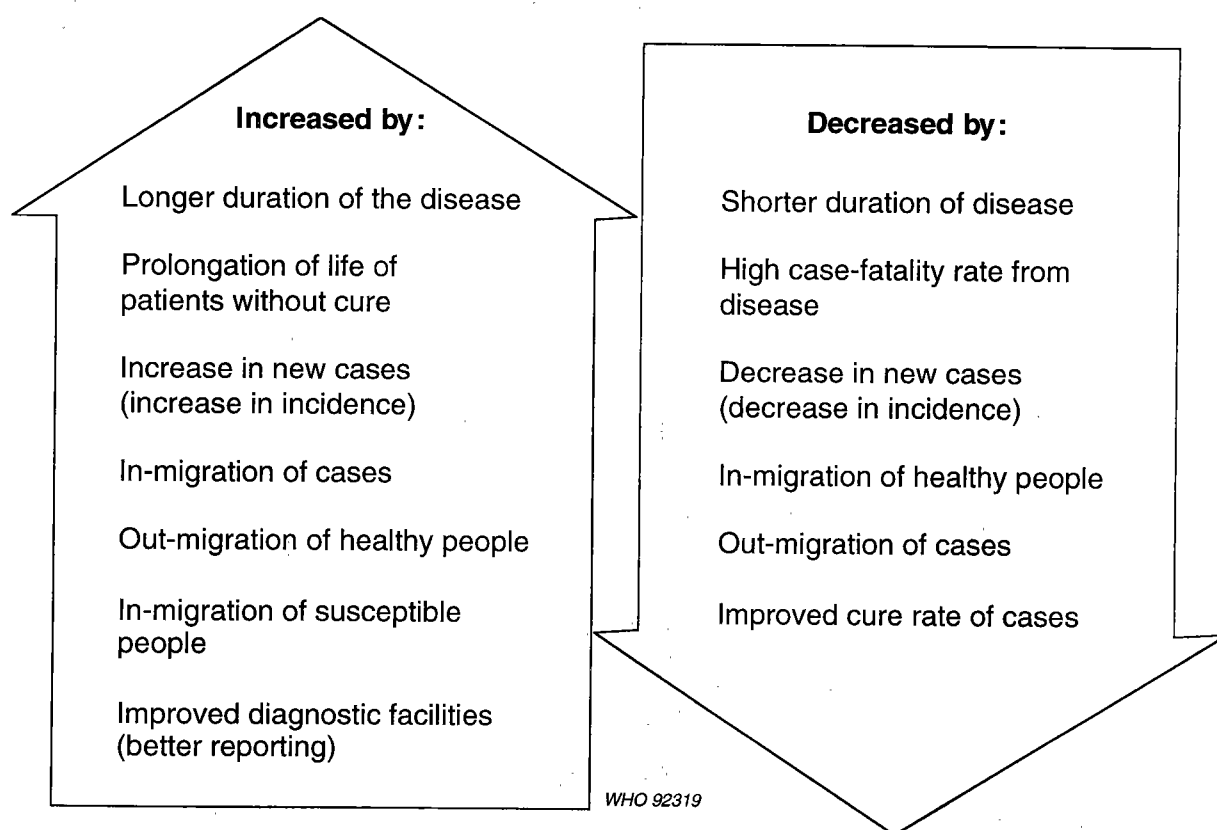
WHO 92318



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For any epidemiological analysis defining the population at risk improves accuracy since the rates will not be "diluted" by including people who cannot contract the disease in the denominator. For cervical cancer, neither men (because they have no cervix), nor young or very old women (because they are unlikely to develop the disease), are included in the population at risk.

Figure 2.2
Factors influencing observed prevalence rate



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Prevalence is influenced — either upwards or downwards — by a number of factors. The duration of the disease is the most obvious factor of importance; the longer the average duration, the higher the prevalence rate if the incidence remains the same. Changes in the population, and diagnostic and curative factors, are also important. Changes in prevalence over time are also difficult to interpret and not necessarily linked to changes in incidence rates.

Table 2.2**Prevalence rate of non-insulin-dependent
diabetes mellitus in selected populations**

Location/population	Age group (years)	Prevalence rate (%)
Fiji Indians	20 +	13.5
Indonesia	15 +	1.7
Israel	40-70	15.9
Malta	15 +	7.7
Mexican Americans/ (USA)	25-64	17.0
Nauru	20 +	24.3
Pima Indians (USA)	25 +	25.5
USA	20-74	6.9

**WORLD HEALTH ORGANIZATION***Source: WHO, 1985.*

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Descriptive data on prevalence rates in different countries may show large variations, as in the case of these diabetes mellitus data assembled by WHO. The age groups are not identical. This may explain some of the variations, but varying case definition may be more significant. Once all such factors have been taken into account, a true variation related to different ethnic backgrounds, genetic factors or environmental exposures can be established. These descriptive data can, regardless of the reason for the variations, be used to assess health service requirements concerning diabetes treatment in different countries.

Table 2.3

Relationship between cigarette smoking and incidence rate of stroke in a cohort of 118 539 women

Smoking category	No. of cases of stroke	Person-years of observation (over 8 years)	Stroke incidence rate (per 100 000 person-years)
Never smoked	70	395 594	17.7
Ex-smoker	65	232 712	27.9
Smoker	139	280 141	49.6
Total	274	908 447	30.2



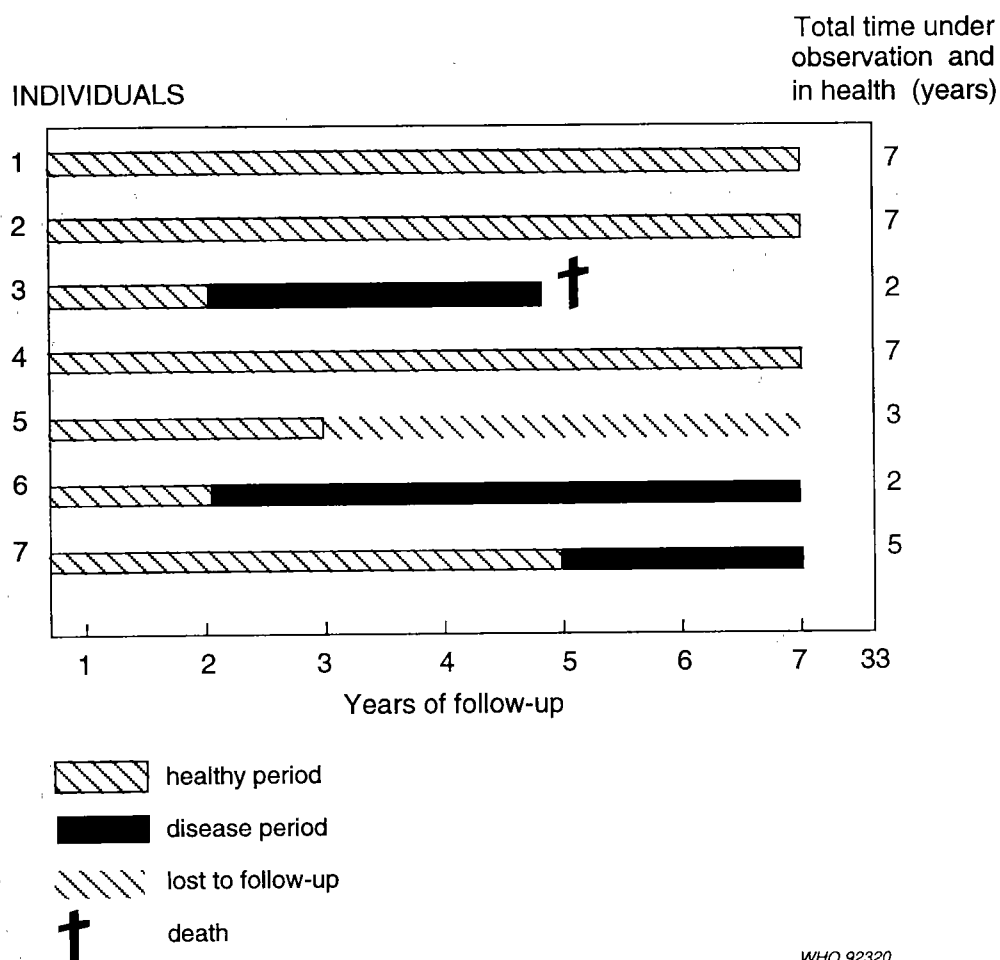
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Source: Colditz et al., 1988. Reproduced by kind permission of the publisher.

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The incidence rate based on person-years of observation gives the most accurate description of the occurrence of new cases of a disease in a population. In order to calculate such a rate, information on mortality in the different subgroups of the population, and on migration out of the population, must be available.

Figure 2.3
Example of calculation of disease occurrence



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This figure demonstrates the basis for calculating the different measures of disease occurrence. Detailed examples are given in the text on pages 20 and 21 of *Basic Epidemiology*. Note that the time under observation that is included in the incidence rate calculation is the accumulated time during which the person was "observed" in a healthy state. (Health data were collected.) As soon as the disease under study occurs, the period of observation ends (assuming that neither recovery nor a second period of disease in the same person is to be studied). A person may be lost to follow-up or observation if the study collects data from a certain geographic area only and the person concerned moves out of this area, or if he or she refuses to continue to provide information for the study, dies, etc.

Table 2.4
Infant mortality rates in selected countries, 1987

Country	Infant mortality rate (per 1000 live births)
Japan	4.8
Sweden	6.1
Switzerland	6.8
Canada	7.3
France	7.8
Australia	8.7
England and Wales	9.0
USA	10.1
Portugal	13.1
Cuba	13.3
Hungary	15.8
Poland	16.2
Chile	18.5
Fiji	19.8
Yugoslavia	25.1
Ecuador	47.7
Morocco ^a	90
Bangladesh ^a	124
Ethiopia ^a	152
Afghanistan ^a	189

^a Figures estimated by UNICEF (1987).



WORLD HEALTH ORGANIZATION

Descriptive data on infant mortality rates show great variation between developed and developing countries. A number of specific preventive actions can be taken to reduce infant mortality including improving maternal care, immunizing the newborn, preventing diarrhoeal disease and acute respiratory infection, and improving nutrition. More generally, economic development, smaller family size, environmental improvements and better primary health care also contribute to prevention. Indeed, many developing countries have achieved dramatic reductions in infant mortality over the last 20 years.

Table 2.5

**Life expectancy (years) at selected ages
for four countries**

Age	Mauritius	Bulgaria	USA	Japan
Birth	65.0	68.3	71.6	75.8
45 years	25.3	27.3	30.4	32.9
65 years	11.7	12.6	15.0	16.2



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Source: WHO, 1990a.

page 57

Life expectancy is another measure of population health that is related to economic development. Rates for life expectancy at birth are very much influenced by the level of infant mortality in those countries where the latter remains high. The differences between countries in terms of life expectancy for older age groups are smaller than those relating to life expectancy at birth, but they are nevertheless significant.

Table 2.6

**Crude and age-standardized mortality rates
(per 100 000) for diseases of the
circulatory system in selected countries, 1980**

	Crude rate	Standard- ized rate, all ages	Age-specific rate	
			45-54 years	55-64 years
Finland	491	277	204	631
New Zealand	369	254	184	559
France	368	164	97	266
Japan	247	154	95	227
Egypt	192	299	301	790
Venezuela	115	219	177	497
Mexico	95	163	132	327

Calculated from data in WHO, 1987a.



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If the occurrence rate for a disease varies with age, then the age-structure of a population will strongly influence the crude rate. If the disease is more common among old people, the crude rate in a population with mainly young people will be lower than in a population with more old people, even if the age-specific rates are the same in the two populations. The table shows that Egypt, which has the highest age-specific mortality rates for circulatory diseases, has one of the lowest crude rates. The age-standardized rate provides a more representative value of the rates in different age groups.

Table 2.7

**Age-standardized mortality rates (per 100 000) in the
30–69-year age group, for coronary heart disease
and stroke**

	Coronary heart disease		Stroke	
	Men	Women	Men	Women
Northern Ireland	406	130	62	50
Scotland	398	142	73	57
Finland	390	79	74	43
Czechoslovakia	346	101	130	75
England and Wales	318	94	52	40
New Zealand	296	94	46	38
Australia	247	76	44	33
USA	235	80	34	26
Poland	230	54	72	47
Greece	135	33	60	44
Portugal	104	32	20	74
France	94	20	45	21
Japan	38	13	79	45



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Source: Uemura & Pisa, 1988.

page 59

Another example of age-standardization, this time for a limited age range. Variations in rates due to the different age structures of the populations have been eliminated. Therefore, the data can be interpreted as showing the real variations in mortality rates among these populations, provided the case definitions are the same in all countries.

Table 2.8

**Hospital admission rates for asthma per 100 000
by age (Auckland, New Zealand)**

Age group (years)	Year		
	1960	1970	1980
0-14	40	160	450
15-44	45	115	200
45-64	70	115	220



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Source: Jackson & Mitchell, 1983. Reproduced by kind permission of the publisher.

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The increases in age-specific hospital admission rates seen in this table are impressive. However, for all morbidity data, factors relating to diagnostic practices and health care utilization must be considered as causes of changes over time.

Handout 2.1

COMPARISONS OF CRUDE, SPECIFIC, AND ADJUSTED RATES

	Advantages	Disadvantages
Crude rates	Actual summary rates Readily calculable for international comparisons (widely used despite limitations)	Since populations vary in composition (e.g. age) differences in crude rates difficult to interpret
Specific rates	Homogeneous subgroups Detailed rates useful for epidemiologic and public health purposes	Cumbersome to compare many subgroups of two or more populations
Adjusted rates	Summary statements Differences in composition of groups "removed", permitting unbiased comparison	Fictional rates Absolute magnitude dependent on standard population chosen Opposing trends in subgroups masked

Source: Mausner & Bahn, 1974.

Teacher's notes 2.1

ROUTINELY AVAILABLE INFORMATION (CENSUS)

The discussion in this section could be directed at country-specific issues by focusing on:

- the methods used and the problems involved in obtaining reliable census data
- how available data can be used to provide information about the population of the country.

Further questions for discussion

1. What are the likely sources of systematic under- or overestimation of subgroups of the population (e.g. ethnic group)?
2. When was the last national census undertaken and how is this likely to affect estimates of any current study population? (Remember, the process of extrapolation from an earlier census requires assumptions about the effects of changing birth rates and migration.)
3. What problems are likely to arise from inaccurate definition of the population's characteristics (age, sex, marital status, place of residence, occupation, etc.) gathered in a national census?
4. Consider the likely impact in your country of using data based on:
 - a) the population present in the census area on the census day, and,
 - b) the permanent residents who live in the census area.

Handout 2.2

SUMMARY: INCIDENCE AND PREVALENCE MEASURES

Rate	Type	Numerator	Denominator
Morbidity rate	Incidence	New cases of non-fatal disease	Total population at risk
Mortality rate	Incidence	Number of deaths from a disease	Total population at risk
Case-fatality rate	Incidence	Number of deaths from a disease	Number of cases of that disease
Incidence rate	Incidence	New cases of the disease occurring in a specific time	Length of time during which each individual in the population is at risk of contracting the disease
Cumulative incidence rate	Incidence	New cases of the disease occurring in a specific time	Number of individuals in the population free of the disease at the beginning of the period
Prevalence	Prevalence	Number of existing cases plus new cases diagnosed during a given time period	Total population

Source: Adapted from Hennekens et al., 1987.

Teacher's notes 2.2

INCIDENCE AND PREVALENCE

It is important that students know the inferences that can and cannot be made by comparing rates over time (secular trends). Consider the following hypothetical rates:

Year	Prevalence (per 1000 pop)	Annual incidence (rate per 1000 pop)
1970	70	15
1980	71	8
1990	69	4
2000	70	1

Compare the secular changes in these rates. What could have produced these relative changes in rates?

Points for discussion

1. The prevalence is steady over time and the incidence rates have declined. This decline may be due to a successful preventive programme or to the etiologic agents of the disease disappearing or decreasing.
2. Explanation for a steady point prevalence over time suggests that case-fatality must be improving (i.e. care has improved so that survival is longer and death rates lower). The cure rate cannot be increasing since that would cause the point prevalence to decline too. Alternatively, the cure rate went up, but was balanced by the immigration of "old" cases which were not included as new cases in incidence—so that the prevalence rate remained steady.
3. The interplay of incidence and prevalence is related to the case-fatality or case-cure rate, i.e. those forces that determine the presence of cases in the prevalence "pool".

7.3 Chapter 3 resources

Learning objectives overhead

Overhead tables and figures from *Basic Epidemiology*

Table 3.1	Types of epidemiological study
Figure 3.1	Maternal mortality rates in Sweden, 1750–1975
Figure 3.2	Age-standardized death rates from stroke among men aged 40–69, three countries, 1970–1985
Table 3.2	Prevalence of smoking in adult men in selected Pacific Islands
Table 3.3	Prevalence of hepatitis-B markers in blood of children in central Tunisia by age
Figure 3.3	The association between quantity of salt sold and oesophageal cancer mortality in counties of Henan province, China
Figure 3.4	Design of a case-control study
Table 3.4	Association between recent meat consumption and enteritis necroticans in Papua New Guinea
Figure 3.5	Design of a cohort study
Figure 3.6	Infant mortality rates according to birth weight in southern Brazil
Table 3.5	Applications of different observational study designs
Table 3.6	Advantages and disadvantages of different observational study designs
Figure 3.7	Design of a randomized controlled trial
Figure 3.8	Randomized controlled trial of early hospital discharge after myocardial infarction
Figure 3.9	Field trial of vaccine against New World cutaneous leishmaniasis
Figure 3.10	Confounding: coffee drinking, cigarette smoking, and coronary heart disease
Figure 3.11	Validity and reliability

Handout

Handout 3.1	Student exercise
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Learning Objectives: Chapter 3

- 1. Describe the main types of epidemiological studies.**
- 2. Demonstrate the advantages and disadvantages of observational studies compared with experimental or intervention studies.**
- 3. Understand study design issues in relation to measuring the occurrence of disease, or health status.**



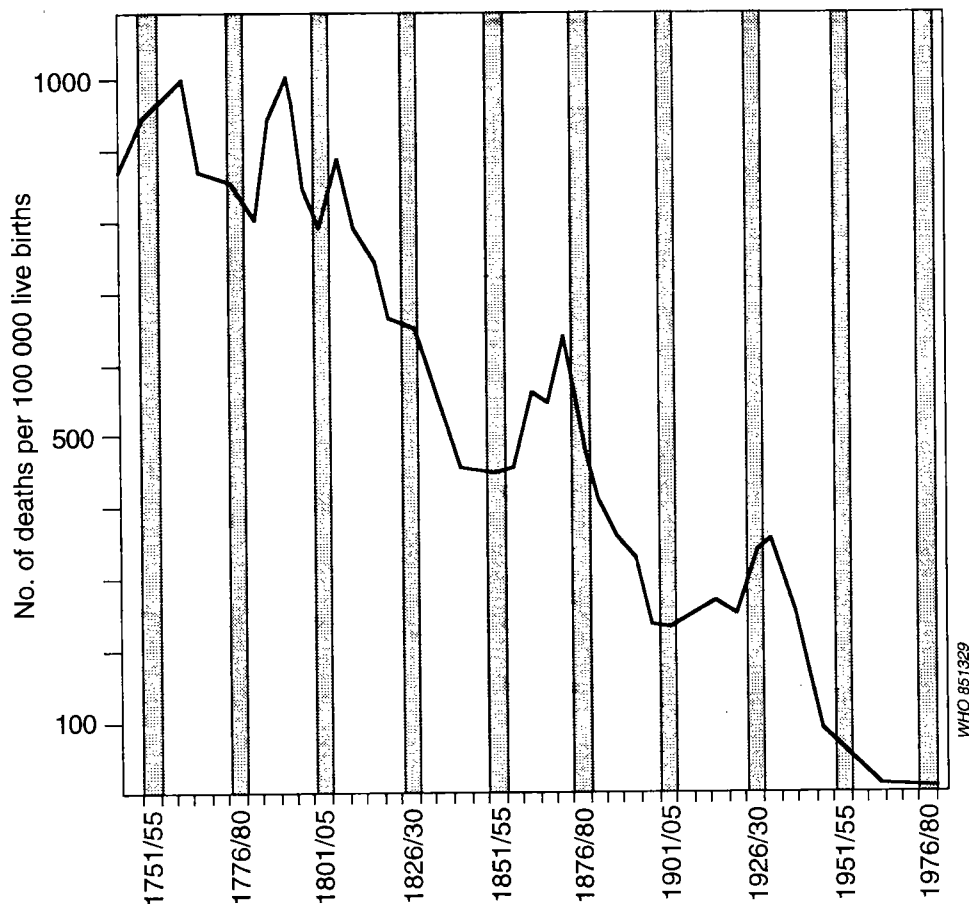
Table 3.1
Types of epidemiological study

Type of study	Alternative name	Unit of study
<i>Observational studies</i>		
Descriptive studies		
Analytical studies		
Ecological	Correlational	Populations
Cross-sectional	Prevalence	Individuals
Case-control	Case-reference	Individuals
Cohort	Follow-up	Individuals
<i>Experimental studies</i>		
<i>Intervention studies</i>		
Randomized controlled trials	Clinical trials	Patients
Field trials	Community intervention studies	Healthy people
Community trials		Communities



This classification of study types includes the most commonly used terms for different study designs. Unfortunately, not all epidemiological study reports use the terms in the same way, and in addition, terms other than those listed here may occasionally appear in the literature. The terms in the left column are those recommended for use in WHO-sponsored research and teaching programmes.

Figure 3.1
Maternal mortality rates in Sweden, 1750–1975



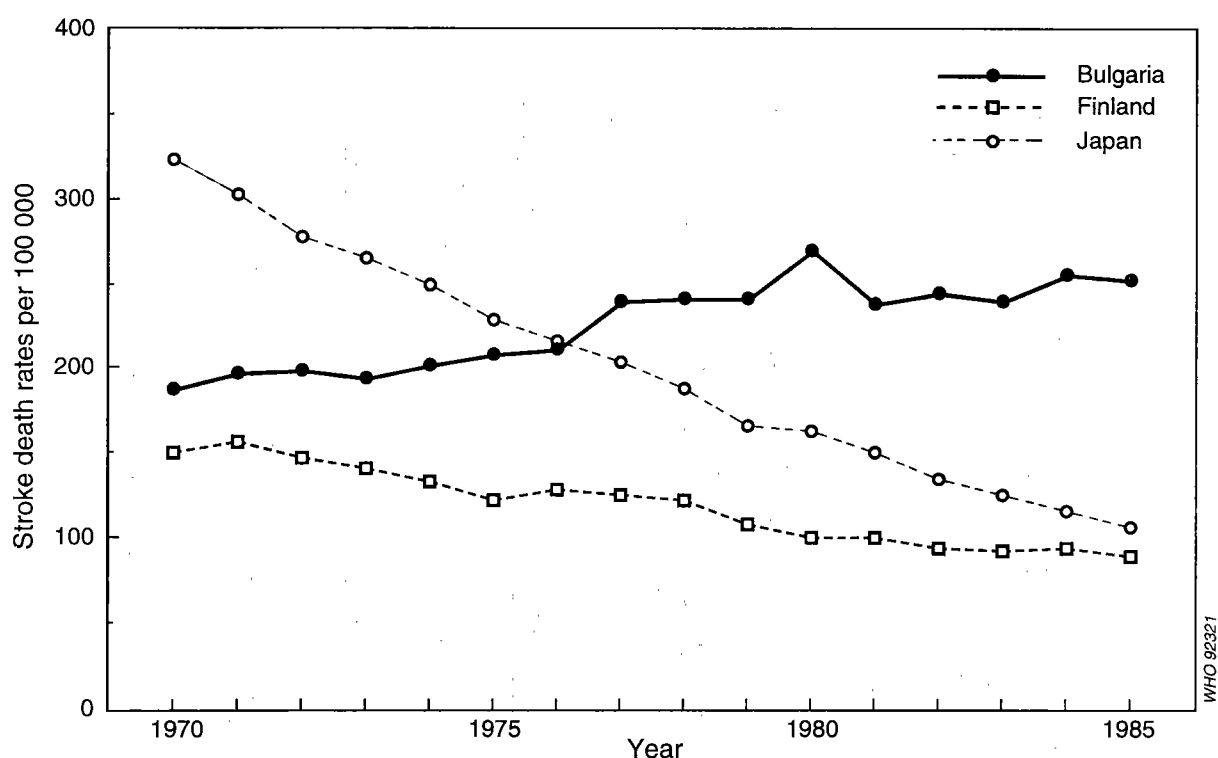
WORLD HEALTH ORGANIZATION

Source: Högberg & Wall, 1986.

page 69

Descriptive time series of data on maternal mortality showing a strong decreasing trend as early as the latter part of the 18th Century. Such data can be of great value for generating hypotheses about factors that influence a disease. In this case, modern medical treatments and improvements in maternal care were not factors until the 20th Century. The decrease in maternal mortality in the 19th Century was probably due to general improvements in housing and environment, as well as to the reduction in family size. However, from the late 19th Century through the early 1930s, socio-economic conditions deteriorated and maternal mortality increased.

Figure 3.2
Age-standardized death rates from stroke among men
aged 40-69, three countries, 1970-1985



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Source: Bonita et al., 1990.

page 70

Another descriptive time series of stroke mortality in three countries showing a tendency towards an increase in Bulgaria, and decreases in Finland and Japan. Most countries have experienced a decrease; increases have been recorded only for Eastern Europe.

Table 3.2

**Prevalence of smoking in adult men in
selected Pacific islands**

Country	Percentage of smokers	
	Urban	Rural
Fiji		
Melanesian	66	88
Asian Indian	42	62
Kiribati	88	84
New Caledonia	76	41
Western Samoa	57	75



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Source: Tuomilehto et al., 1986.

page 71

Descriptive data can also refer to exposure to factors which cause diseases, as in this example of smoking habits among different Pacific Island communities.

Table 3.3

**Prevalence of hepatitis-B markers in blood of children
in central Tunisia by age**

Age group (years)	Prevalence of hepatitis B markers (%)
1-3	7
4-6	16
7-9	21
10-12	24



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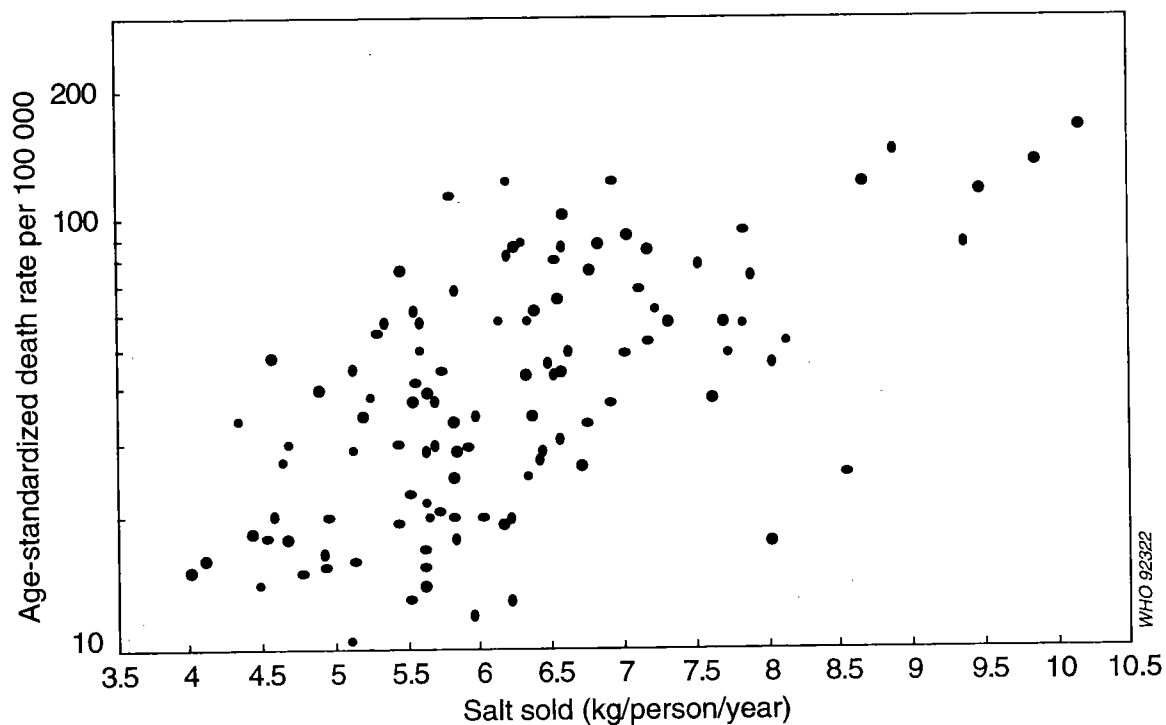
Source: Said et al., 1985.

page 72

A third example of descriptive data for a biomarker, hepatitis-B serological changes. The data show that 7% of children between the ages of 1 and 3 years have had hepatitis B already. The prevalence of individuals who have had hepatitis B must increase with age since these markers remain in the blood throughout the person's life. An approximate calculation can be made of the incidence at different ages from these data. From age 3 to 6 years an additional 9% have had hepatitis B. Thus the annual incidence would be about 3 %. For children of 6 to 9 years the annual incidence would be about 1.7% (5/3), and for those of 9 to 12 years it would be 1%.

Figure 3.3

The association between quantity of salt sold and oesophageal cancer mortality in counties of Henan province, China



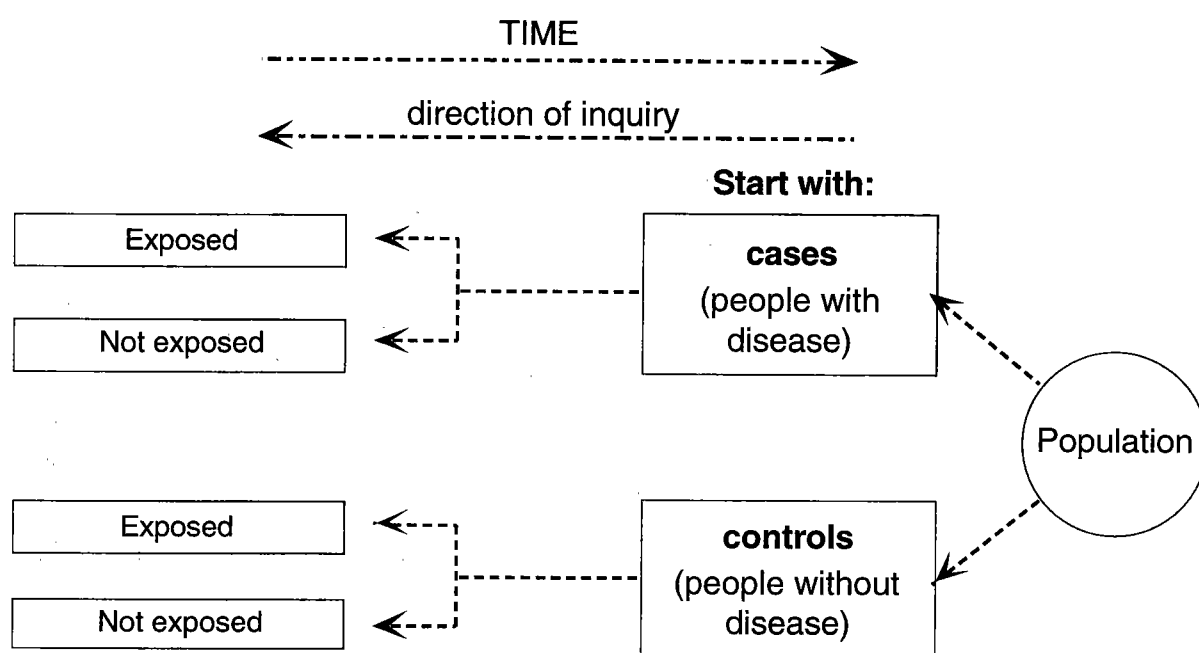
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Source: Lu & Qin, 1987. Reproduced by kind permission of the publisher.

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This comparison of average salt intake and oesophageal cancer mortality in each county of Henan province in China is ecological because the data on salt intake is not based on information from individuals. An ecological analysis is often more likely to be biased or confounded by factors other than the one being studied. Note that the axes in the graph do not start at the origin (zero). The perceived relationship between the variables may be exaggerated by the choice of scales on the axes and the positioning of the origin. The axes of graphs should always be checked before visual interpretations are made.

Figure 3.4
Design of a case-control study



WHO 92323



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In a case-control study the starting point is cases with the disease in a population. The previous exposure of the cases is analysed and a representative sample of controls (without the disease being studied) selected from the same population. The direction of enquiry is always backwards in time, but the actual data collection can be carried out in either a retrospective manner (backwards in time from the time the study started) or a prospective manner (forwards in time from the start of the study).

Table 3.4

**Association between recent meat consumption and
enteritis necroticans in Papua New Guinea**

		Exposure (recent meat ingestion)		
		Yes	No	Total
Disease (enteritis necroticans)	Yes	50	11	61
	No	16	41	57
Total		66	52	118



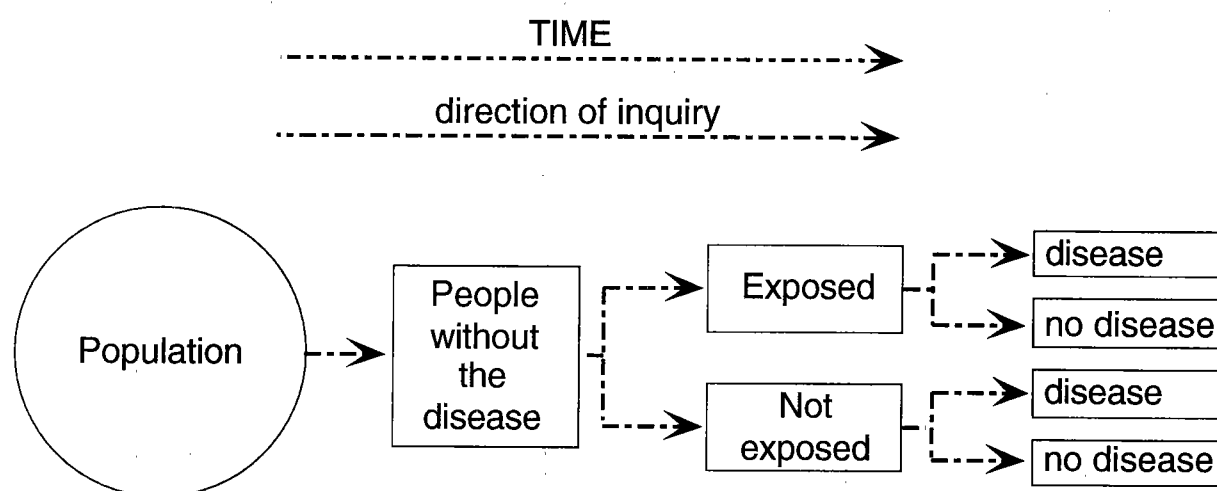
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Source: Millar et al., 1985. Reproduced by kind permission of the publisher.

page 75

This is a typical simple analysis of case-control data. The previous exposure to meat for cases of enteritis and controls has been recorded and entered into a 2 by 2 table. From this the odds ratio can be calculated as shown on page 38 of *Basic Epidemiology*.

Figure 3.5
Design of a cohort study



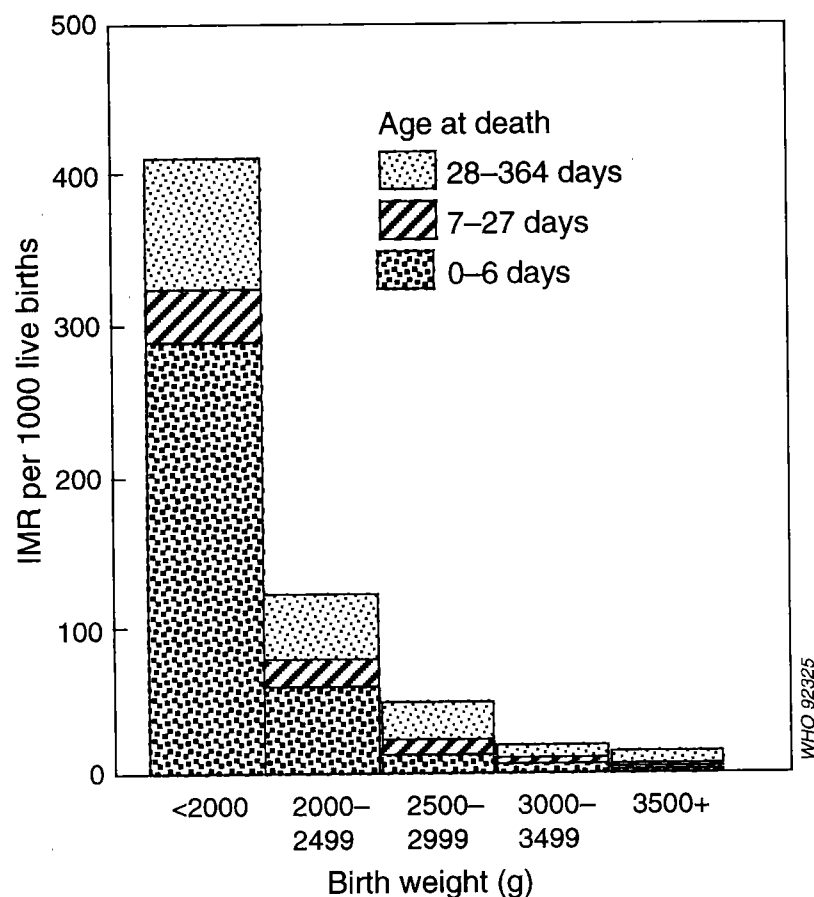
WHO 92324



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In a cohort study a group of people free of the disease which is being investigated is selected. Exposure to the factor which is being studied is measured during "follow up", as is the subsequent development of the disease. The direction of enquiry is always in the same direction as time, but data can be recorded both retrospectively and prospectively, as for case-control studies.

Figure 3.6
Infant mortality rates according to birth weight
in southern Brazil



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Source: Victoria et al., 1987. Reproduced by kind permission of the publisher.

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A cohort study of birth weight. Children were classified into different birth weight categories and the subsequent mortality in the first year of life was measured. The correlation between decreasing birth weight and increasing infant mortality is obvious.

Table 3.5
Applications of different observational study designs

	Ecological	Cross-sectional	Case-control	Cohort
Investigation of rare disease	++++	-	+++++	-
Investigation of rare cause	++	-	-	+++++
Testing multiple effects of cause	+	++	-	+++++
Study of multiple exposures and determinants	++	++	++++	+++
Measurements of time relationship	++	-	+ ^b	+++++
Direct measurement of incidence	-	-	+ ^c	+++++
Investigation of long latent periods	-	-	+++	-

^a **Key:** + ... +++++ indicates the degree of suitability
- not suitable

^b if prospective

^c if population-based



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This table makes it possible to assess the most appropriate study design for different situations. For example, if a rare disease is being studied, an ecological or case-control design would be the most suitable. If the cause is rare, a cohort design would be more appropriate. The indications of applicability of different designs should be used only for initial guidance. The final choice of design will depend on availability of crucial data and other operational issues, and deviation from the table's proposals may be required.

Table 3.6

Advantages and disadvantages of different observational study designs

	Ecological	Cross-sectional	Case-control	Cohort
Probability of:				
selection bias	NA	medium	high	low
recall bias	NA	high	high	low
loss to follow-up	NA	NA	low	high
confounding	high	medium	medium	low
Time required	low	medium	medium	high
Cost	low	medium	medium	high

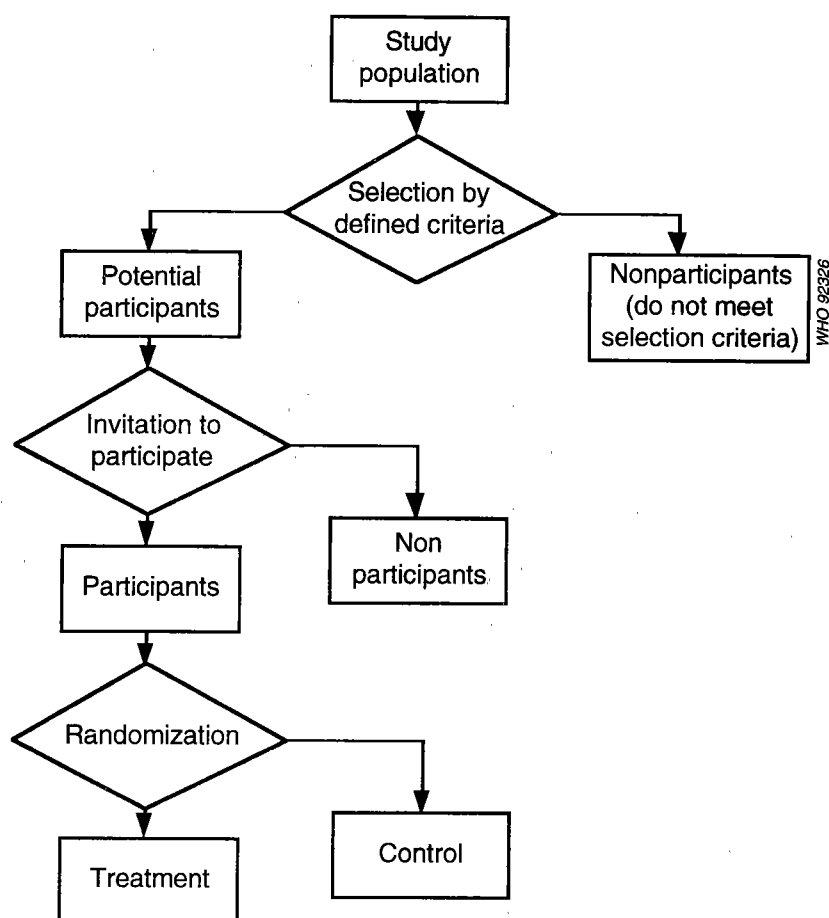
NA: not applicable.



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These approximate assessments of advantages and disadvantages of different study designs can be used for guidance, but in a particular situation it will be local availability of data and the extent of opportunities for convenient data collection which will determine the time and cost of a study.

Figure 3.7
Design of a randomized controlled trial

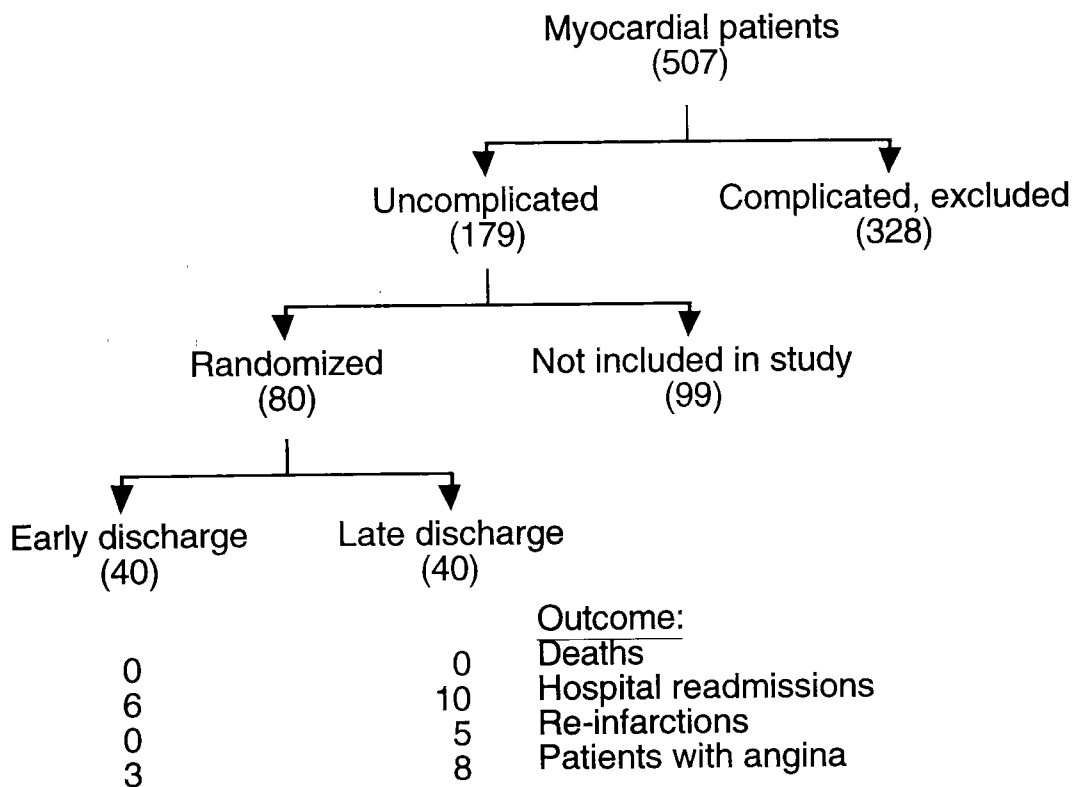


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This scheme does not indicate that examination of the impacts of interventions on the health of the treatment and control groups will be similar to the study of disease or absence of disease in the cohort design (Figure 3.5). The random allocation of participants to either a group receiving some treatment or subject to an intervention, or to a group not subject to any intervention (the control), provides a very powerful scientific basis for drawing conclusions about causation of the health impact of the interventions. In the ideal cohort study the occurrence of exposure is a random event, as in the randomized controlled trial.

Figure 3.8

Randomized controlled trial of early hospital discharge after myocardial infarction



WHO 92327



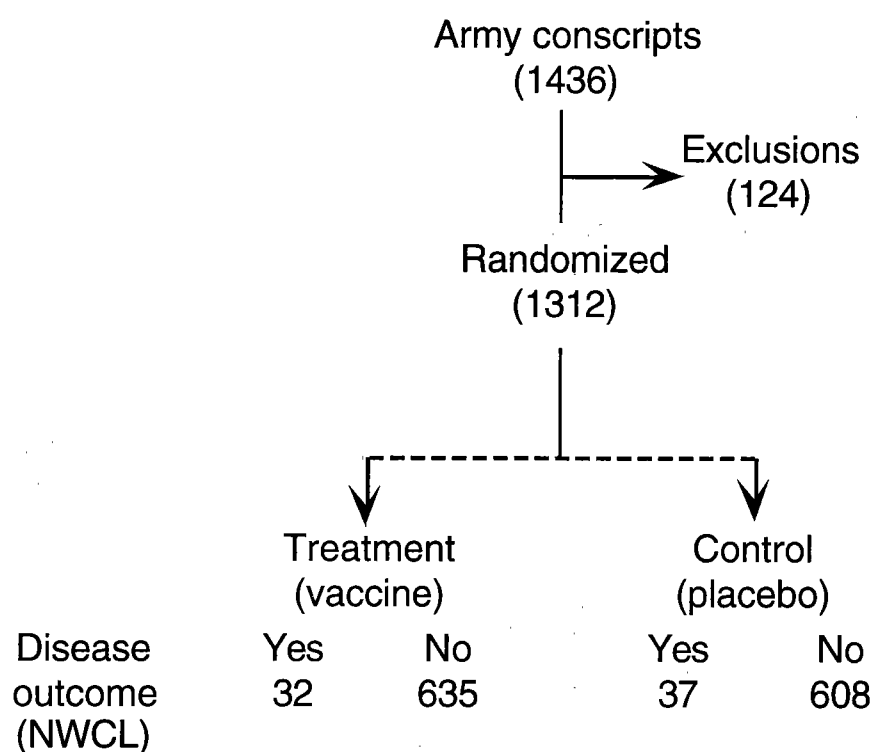
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Source: Topol et al., 1988. Reproduced by kind permission of the publisher.

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This diagram shows the sequential selection of patients for a randomized controlled trial. The interpretation of the results will be very much influenced by the very large number of patients excluded from the initial selection (328 of 507). In addition, 99 of the 179 initially selected patients were not included in the actual randomization. Ideally, there should be no differences between the health status or exposures of the 80 patients participating in the study and those of the 99 not participating.

Figure 3.9
Field trial of vaccine against New World cutaneous leishmaniasis (NWCL)



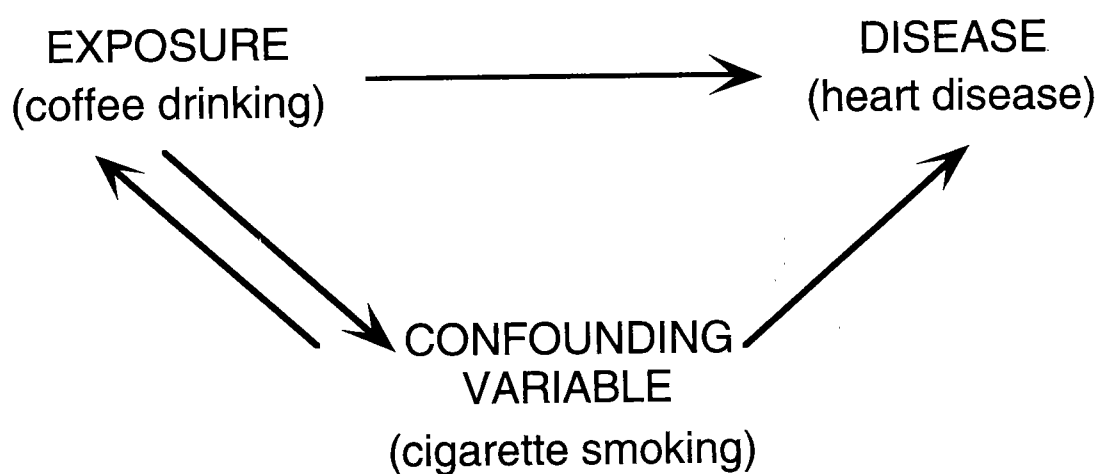
WHO 92328



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In this study, the health effects assessment of the two randomized groups (treatment and control) is clearly indicated. In terms of disease incidence there is very little difference between those who were given vaccine and the controls. Thus the vaccine appears to have no protective value.

Figure 3.10
**Confounding: coffee drinking, cigarette smoking,
and coronary heart disease**



WHO 92329

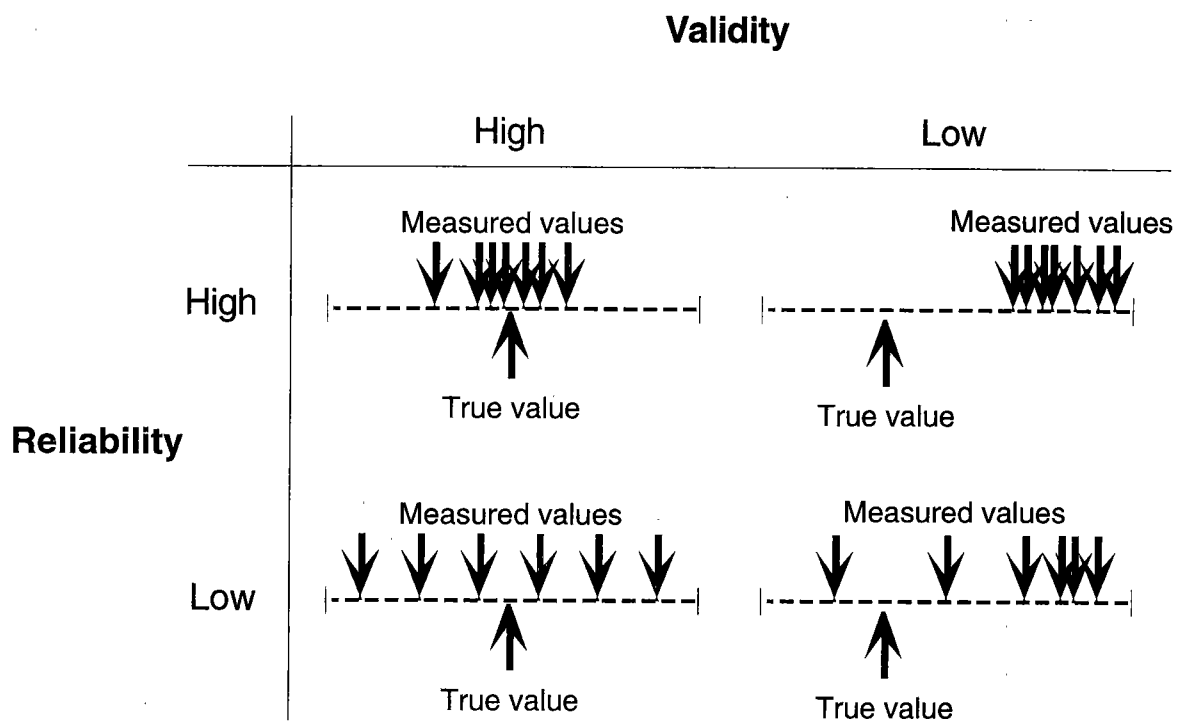


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Confounding occurs when a factor other than the one being studied is associated both with the disease and the factor being studied. In this case the study indicates an association between coffee drinking and heart disease. Cigarette smoking is a confounding variable because it is known that it causes heart disease and in addition it is associated with coffee drinking; those who drink lots of coffee on average smoke more than those who drink little coffee.

Figure 3.11
Validity and reliability



WHO 92330



WORLD HEALTH ORGANIZATION

A high reliability means that in repeated measurements the results fall very close to each other; conversely, a low reliability means that they are scattered. Validity determines how close the mean of repeated measurements is to the true value. A low validity will produce more problems when interpreting results than a low reliability.

Handout 3.1

STUDENT EXERCISE

The following table indicates results of testing blood samples from an isolated Fijian community for antibodies to the hepatitis B virus.

Age at time of testing (years)	Women		Men	
	Number tested	Number positive	Number tested	Number positive
15-24	171	27	58	10
25-34	44	9	32	5
35-64	35	12	25	8
Total	250	48	116	23

1. This study should be classified as (choose one):
 - a. an incidence study
 - b. a cohort study
 - c. a case-control study
 - d. a cross-sectional study
 - e. none of the above

2. For comparison with overall rates for other populations these data should be (choose one):
 - a. adjusted for age
 - b. adjusted for sex
 - c. adjusted for both age and sex

PAGE 2 OF HANDOUT 3.1

- d. not adjusted
 - e. rearranged so that the actual numbers of cases can be compared
3. One can infer from these data that (choose one):
- a. the incidence of hepatitis B infection increases with age
 - b. the risk for males of acquiring infection through the hepatitis B virus is the same as for females
 - c. antibody prevalence is distributed approximately equally between the sexes
 - d. none of the above
 - e. all of the above
4. Inference (choose one): the risk of infection by hepatitis B virus for a person residing in the tropical and subtropical regions of the South Pacific increases progressively with age:
- a. the inference is correct
 - b. the inference is incorrect because the inference concerning risk is based on incidence data
 - c. the inference is incorrect because cohort effect could account for the result
 - d. the inference is incorrect because of strong participant bias
 - e. the data is not sufficient to make an inference

7.4 Chapter 4 resources

Learning objectives overhead

Overhead explanation

Overhead 4.1 Measurement of health and disease in populations

Overhead tables and figures from *Basic Epidemiology*

Table 4.1	Distribution of mercury concentrations in hair of 300 high school students
Figure 4.1	Bar chart showing prevalence of rheumatoid arthritis among men and women over 55 years of age in the USA and Indonesia
Figure 4.2	Histogram of mercury concentrations in hair of 300 high school students
Figure 4.3	Smooth curve fitted to the data shown in Figure 4.2
Figure 4.4	The normal distribution curve
Figure 4.5	Confidence intervals associated with different confidence levels
Figure 4.6	Areas under the normal curve
Table 4.2	Calculation of χ^2 statistic
Figure 4.7	Regression of the prevalence of underweight children on per capita energy intake for 11 Asian countries

Handout and teacher's notes

Handout 4.1	Exercise on confounding
Teacher's notes 4.1	Answers to exercise on confounding

Learning Objectives: Chapter 4

- 1. Describe the basic statistical concepts and techniques used in epidemiology.**
- 2. Outline the steps necessary to test hypotheses.**
- 3. Demonstrate how to evaluate the relationship between two variables.**



Overhead 4.1

MEASUREMENT OF HEALTH AND DISEASE IN POPULATIONS

Information on the health of a community or some other defined population is essential as a basis for:

- **measuring the health of a community**
- **planning and evaluating health services**
- **ensuring that the usually limited funds for health initiatives are used as effectively as possible.**

REMEMBER!

The central tool of epidemiology is the measurement and comparison of rates of health-related events in groups of people.



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Table 4.1

**Distribution of mercury concentrations in hair
of 300 high school students**

Mercury concentration ($\mu\text{g/g}$)	No. of children
0–0.49	95
0.5–0.99	91
1.0–1.49	47
1.5–1.99	30
2.0–2.49	16
2.5–2.99	8
3.0–3.49	9
3.5–3.99	4



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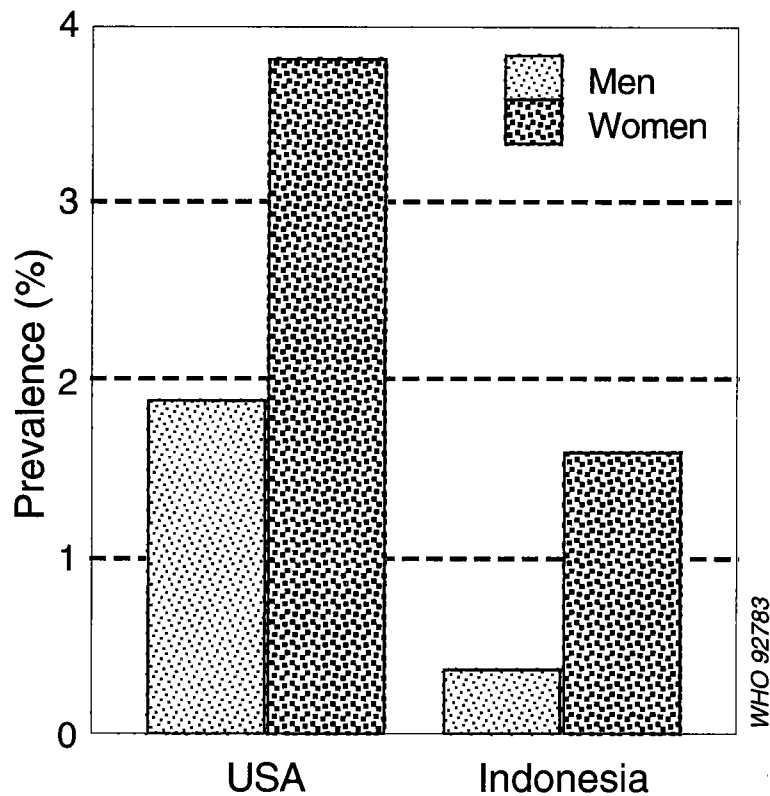
Adapted from Kjellström et al., 1982.

page 91

A typical frequency distribution table with identical group ranges ($0.5 \mu\text{g/g}$ each). Often the first descriptive assembly of data carried out in a study.

Figure 4.1

Bar chart showing prevalence of rheumatoid arthritis among men and women over 55 years of age in the USA and Indonesia



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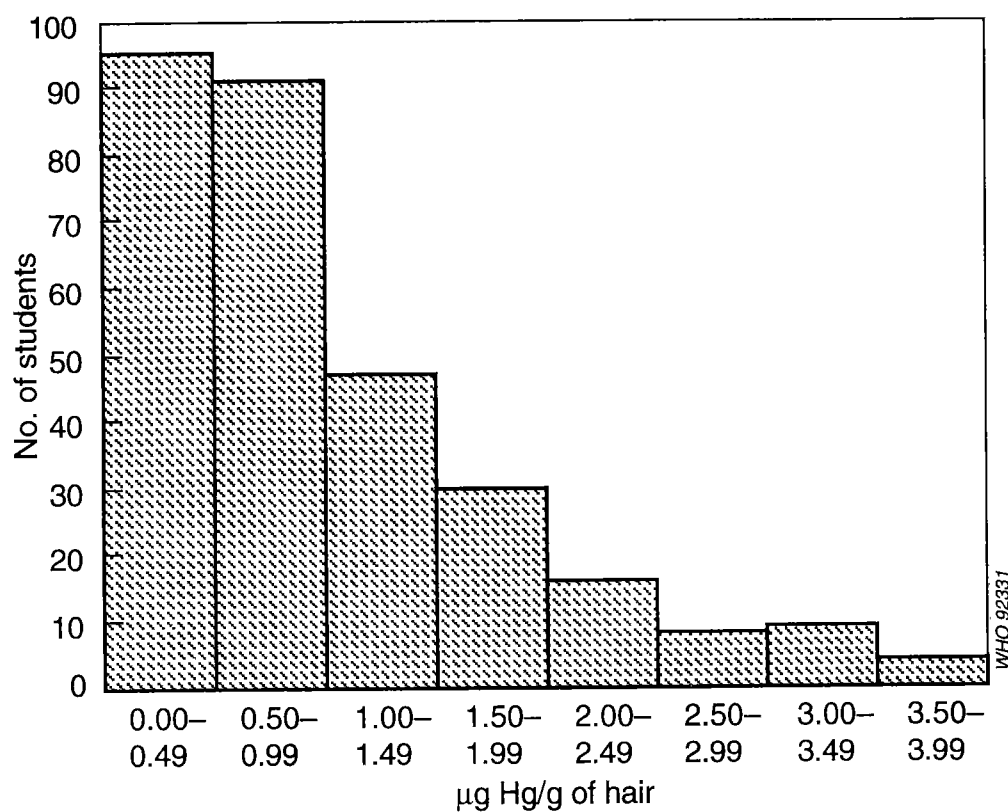
Source: Darmawan, 1988.

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Bar charts give a visual impression of differences between groups. Here the higher rates of rheumatoid arthritis among women (as compared to men) and the difference in prevalence between women in the USA and women in Indonesia are obvious. It should be pointed out that this chart starts the y-axis at the origin (zero). This is very important for the correct visual impression. Many bar charts are now produced with truncated y-axis (starting at a level higher than the origin), which produces a distorted visual impression.

Figure 4.2

Histogram of mercury concentrations in hair of 300 high school students



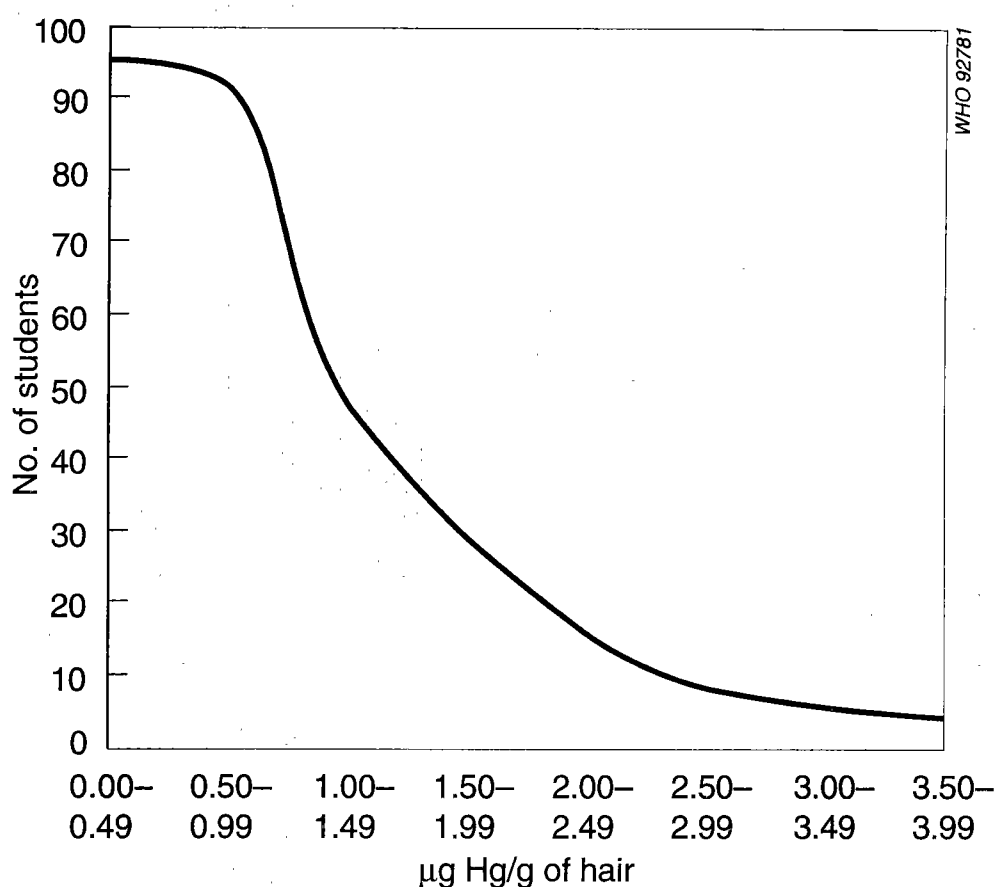
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Source: Kjellström et al., 1982. Reproduced by kind permission of the publisher.

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A histogram of the results presented in Table 4.1, producing an easily interpreted visual image of the frequency distribution of hair mercury levels.

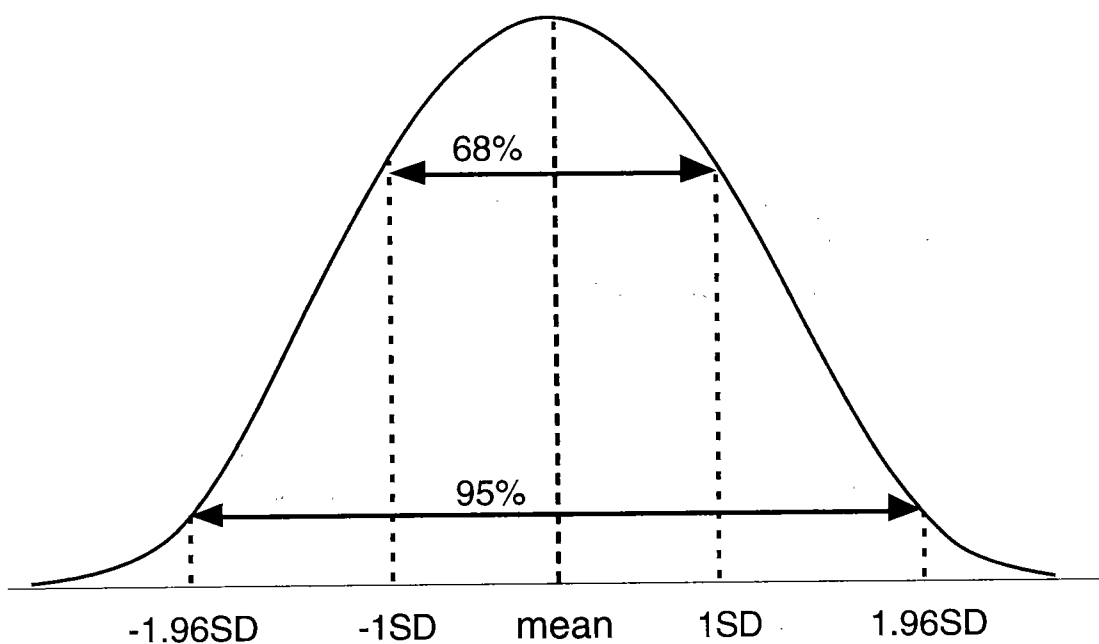
Figure 4.3
Smooth curve fitted to the data shown in Figure 4.2



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This smooth curve gives a similar visual image of the frequency distribution, but eliminates the link to the originally collected group data. Smooth curves are most often used when a frequency distribution has been converted from the original data distribution to a percentage distribution. In this case, with about 300 students in the original hair mercury study, the y-axis would be equivalent to a 30% frequency.

Figure 4.4
The normal distribution curve



WHO 92332

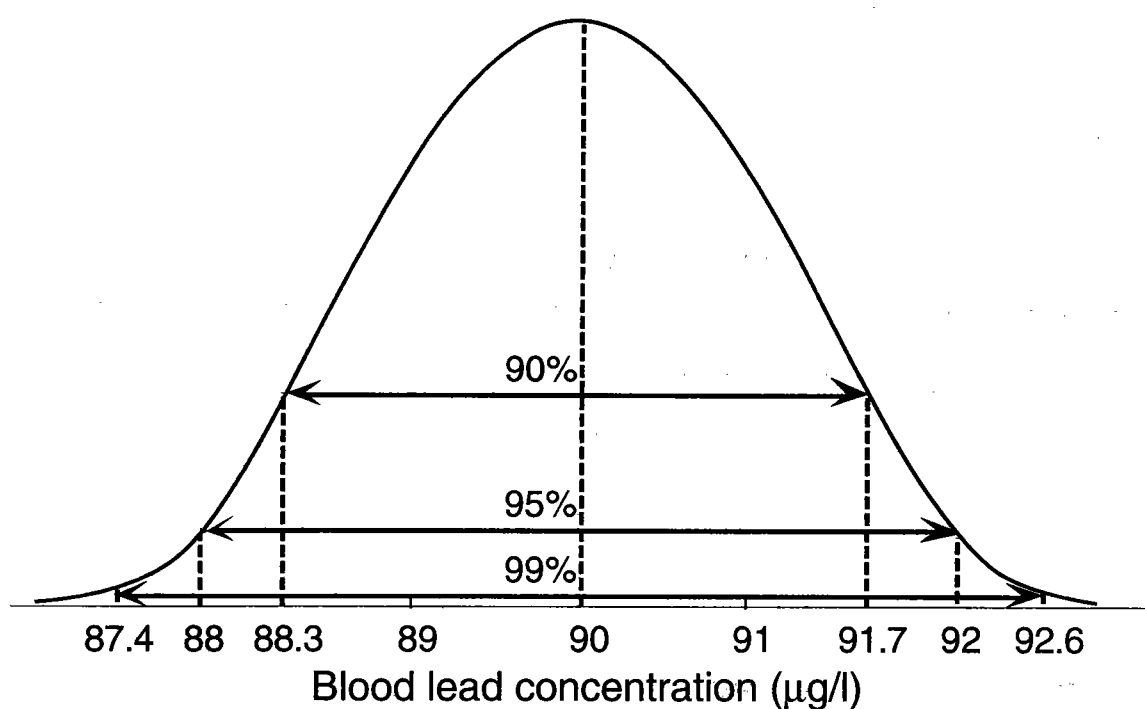


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The “normal” distribution, or Gaussian distribution as it is also called, is a very useful concept in statistics. Many epidemiological variables are distributed in this manner, or when they are not, due to skewed data, the logarithms of the variable values are often distributed as a normal distribution (the log-normal distribution). The Poisson distribution of rare events is another common distribution of epidemiological data.

Figure 4.5
Confidence intervals associated with different confidence levels



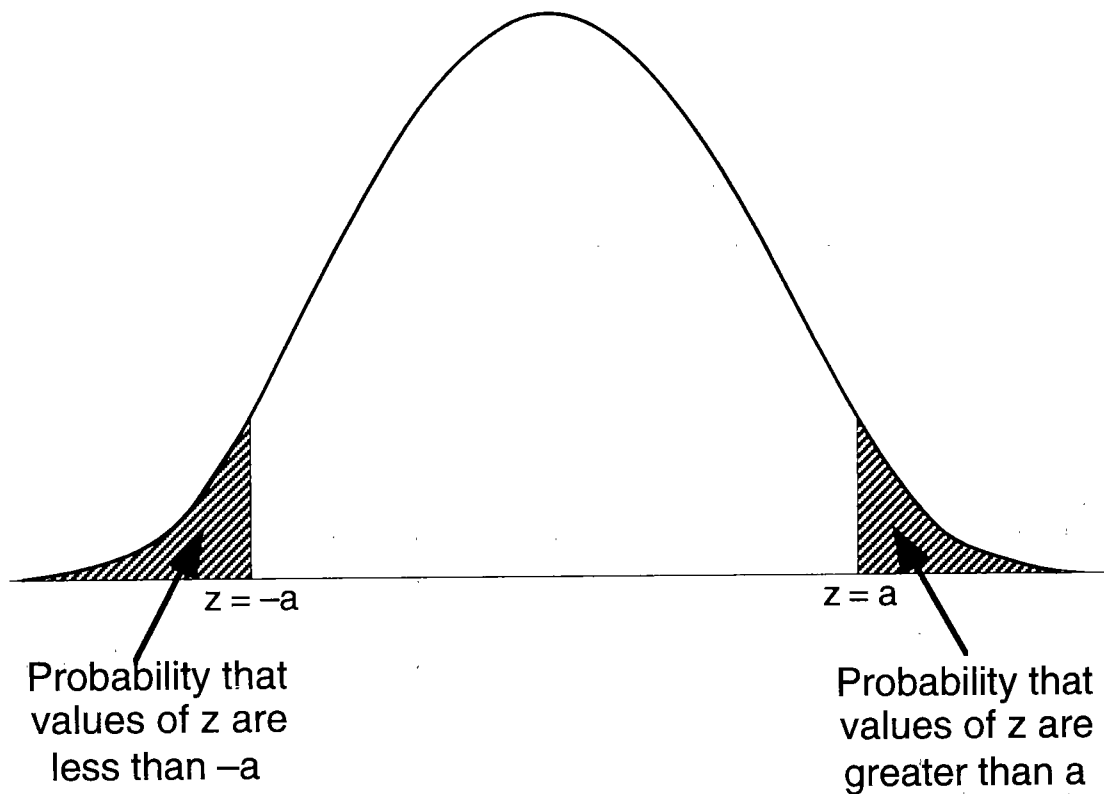
WHO 92782



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With a normal distribution it is easy to establish confidence intervals for estimates of, for instance, mean blood lead concentrations. The term "confidence interval" describes the range within which a mean will fall, while "tolerance interval" describes the range within which individual values fall.

Figure 4.6
Areas under the normal curve



WHO 92334



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The extreme ends of the normal distribution are of especial interest as they identify data that are particularly high or low. These may represent the most sensitive or vulnerable individuals in a population, or those most likely to develop disease. The term percentile is used to identify extremes above a certain percentage of the study population; for example, the 99th percentile is the level above which only the most extreme 1% of the data falls.

Table 4.2

Calculation of χ^2 statistic

	Variable A		Total
	present	absent	
Variable B	present	a b	$a + b$
	absent	c d	$c + d$
Total	$a + c$	$b + d$	n

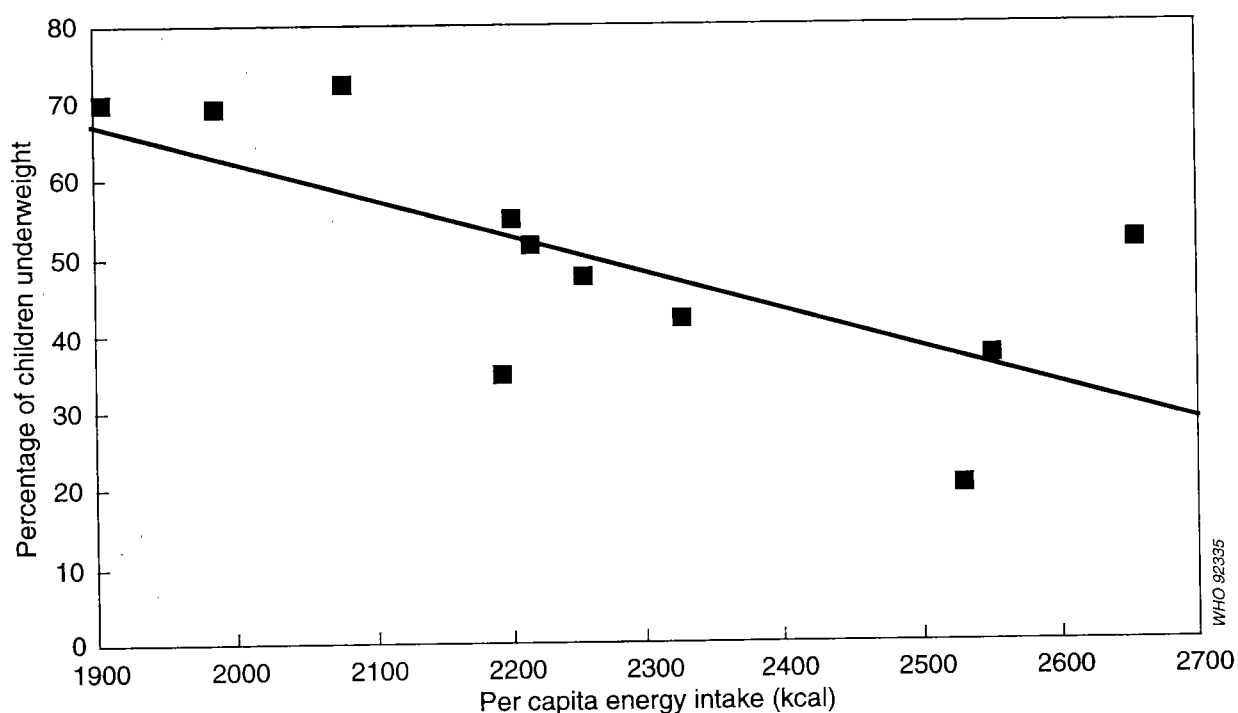
$$\chi^2 = \frac{(|ad - bc| - n/2)^2 n}{(a + b)(a + c)(c + d)(b + d)}$$



The chi-squared (χ^2) statistic is very useful for assessing whether the data in a categorical table is distributed in the same way as the summed data at the margins of the table, or whether the data are skewed in one or other direction within the table. Many calculators and microcomputer software used in statistics have the χ^2 calculation pre-programmed, so that memorizing the formula becomes unnecessary.

Figure 4.7

Regression of the prevalence of underweight children on per capita energy intake for 11 Asian countries



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The regression line provides a summary measure of the association between the prevalence of underweight children and average energy intake, as presented by the data for the specific countries. Ideally, the confidence interval for the regression line should be indicated in the same graph in order to give a visual impression of the precision of the line.

Handout 4.1

EXERCISE ON CONFOUNDING

Vaccine acceptance as a result of knowledge of the cause of poliomyelitis (%)

	Knowledge of Causes		
	Virus	Dirt/flies	Don't know
Took vaccine	78%	67%	51%
Did not take vaccine	22%	33%	49%
Total	100%	100%	100%
(n)	(214)	(80)	(100)

Questions

1. How many variables are included in this table?
2. What describes the number for the 51%?
3. From this table, do you know that "better" knowledge of the cause of polio is associated with vaccine acceptance? Why do you think that?
4. Which antecedents ("causes") cause what (knowledge or vaccine acceptance)? Why do you think that?

Teacher's notes 4.1

ANSWERS TO EXERCISE ON CONFOUNDING

1. Two variables, knowledge of causes of poliomyelitis and vaccine taking.
2. The acceptance rate of those who didn't know the cause of poliomyelitis, i.e. the number of people who said "don't know" as a cause of polio *and* took the vaccine. Of the 100 who said "don't know" to the cause of poliomyelitis, 51% accepted the vaccine. The numerator must have been 51 persons or 51% of 100.
3. The table suggests that the greater the knowledge of the cause of poliomyelitis, the greater the vaccine acceptance rate. It is possible to compare the data because it is presented in rates (the percentages are rates of 100).

However, it is also possible that the relationship between taking the vaccine and knowledge about the vaccine is confounding the relationship. If a greater number of older people (or more educated people) takes the vaccine, taking with knowledge may be due only to the mutual association of knowledge and vaccine taking with age (education).

CONFOUNDING

Age -----> Taking vaccine

KNOWLEDGE

4. It is not possible to deduce from the table which "causes" which. Knowledge could precede and in fact motivate vaccine acceptance, but information may be given to the vaccine takers and therefore the vaccine taking may precede knowledge. This is an example of one of the major weaknesses of cross-sectional studies: namely, it is not possible to determine the relationship between cause and effect.

Source: Sloane, 1978.

7.5 Chapter 5 resources

Learning objectives overhead

Overhead tables and figures from *Basic Epidemiology*

Figure 5.1	Causes of tuberculosis
Figure 5.2	Causes of cholera
Figure 5.3	Assessing the relationship between a possible cause and an outcome
Table 5.1	Guidelines for causation
Figure 5.4	Frequency of seat-belt use and injury occurrence in the United Kingdom
Figure 5.5	Meta-analysis of selected randomized trials of beta-blockers in the prevention of deaths following a myocardial infarction
Table 5.2	Percentage of people with hearing loss
Table 5.3	Relative ability of different types of study to "prove" causation

Handouts and teacher's notes

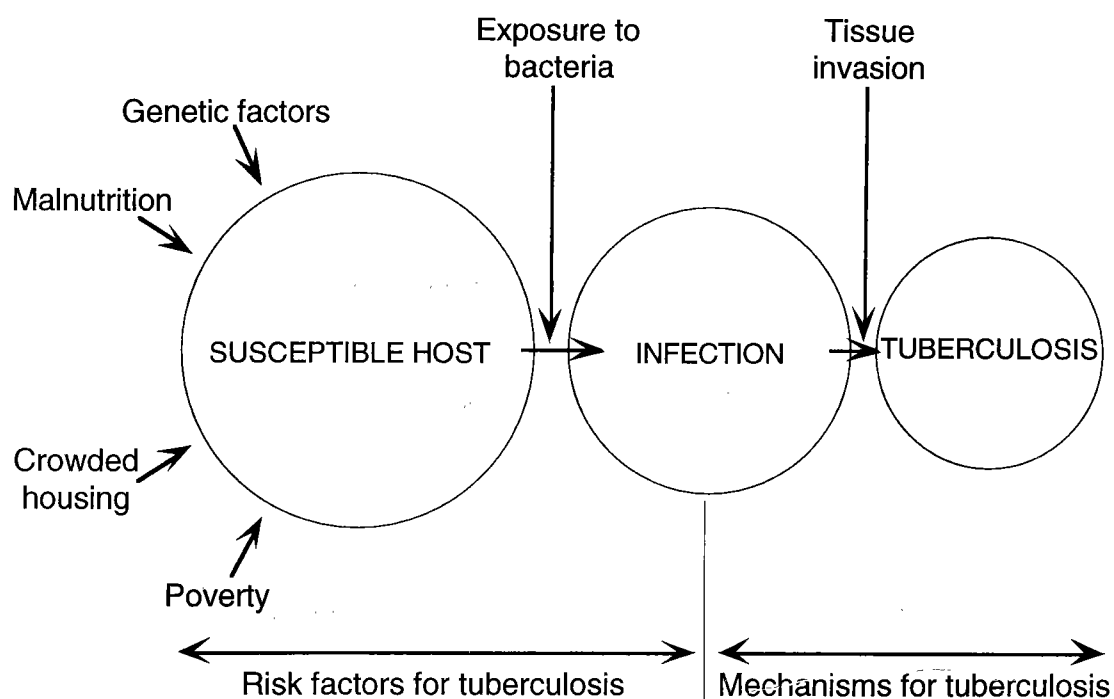
Handout 5.1	Acute outbreak of disease and death associated with extreme air pollution
Teacher's notes 5.1	Suggested answers to the London Fog exercise

Learning Objectives: Chapter 5

- 1. Understand the role of epidemiology in the prevention and control of disease through identification of the causes of disease.**
- 2. Outline the steps necessary to establish the cause of a disease.**



Figure 5.1
Causes of tuberculosis



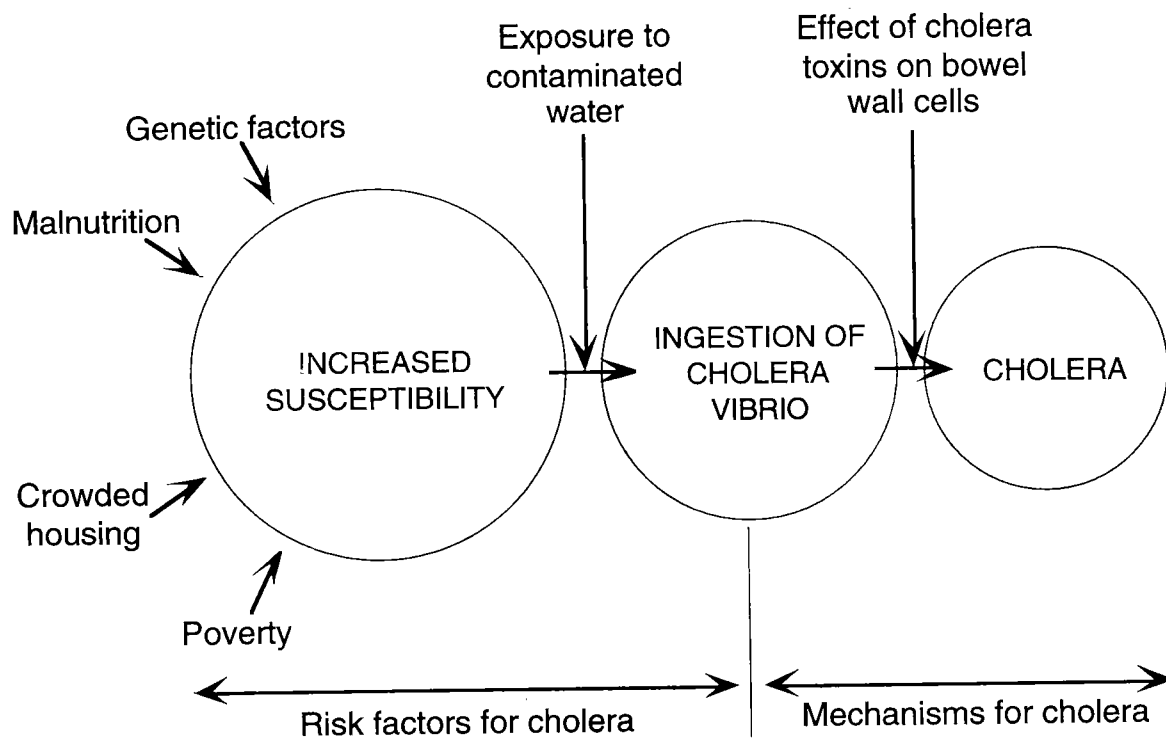
WHO 92336



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A variety of factors contribute to the causation of tuberculosis infection; the exposure to a sufficient amount (the infection dose) of the specific bacteria is, of course, a necessary factor. After infection has occurred, it is internal factors relating to tissue invasion and immunological defences which influence whether or not clinical tuberculosis develops.

Figure 5.2
Causes of cholera



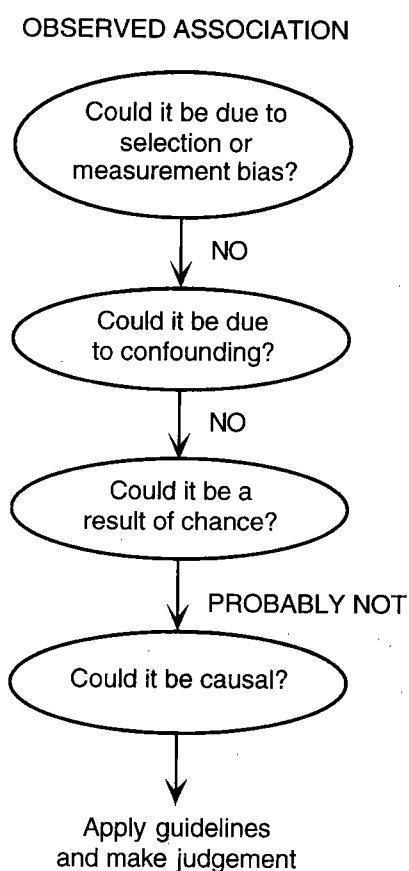
WHO 92337



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The factors contributing to the causation of cholera are similar to those associated with tuberculosis, but the specific bacteria differ, and the disease manifestations are very different. The most common route of infection is via contaminated drinking water as was the case in Latin America in 1991 when cholera became first epidemic and later endemic (in poor areas). The severity of the clinical disease depends on internal factors.

Figure 5.3
Assessing the relationship between a possible cause and an outcome



WHO 92338



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The figure describes the steps involved in analysing causation. Firstly, the possibility of selection or measurement bias must be examined. Secondly, confounding should be considered. Thirdly, statistical analysis should be used to determine the probability of the findings having occurred by chance. If these three possible explanations for an apparent association can each be ruled out, the issue of causation can then be tackled.

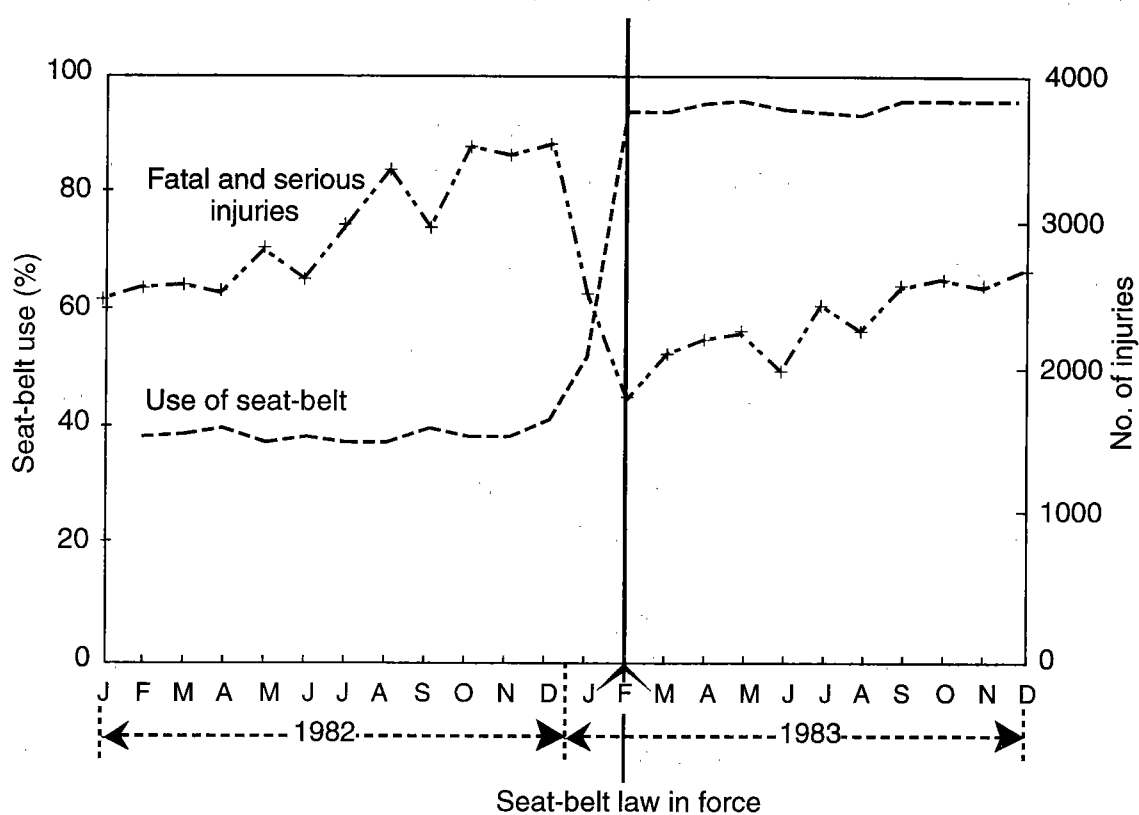
Table 5.1
Guidelines for causation

Temporal relation	Does the cause precede the effect? (essential)
Plausibility	Is the association supported by other knowledge (mechanism of action; evidence from animal experiments)?
Consistency	Have other studies shown similar results?
Strength	What is the strength of the association between the cause and the effect? (relative risk)
Dose-response relationship	Is increased exposure to the possible cause associated with increased effect?
Reversibility	Does the removal of a possible cause lead to reduction of disease risk?
Study design	Is the evidence based on a strong study design?
Judging the evidence	How many lines of evidence lead to the conclusion?



These guidelines for analysing causation are listed in order of importance. That the cause must precede the effect is self-evident. Available knowledge about the mechanism of action of a health hazard will help to assess how likely it is that the association is causal. The other factors listed will also help, but their importance will depend on the particular problem being studied.

Figure 5.4
Frequency of seat-belt use and injury occurrence in the United Kingdom



WHO 92339



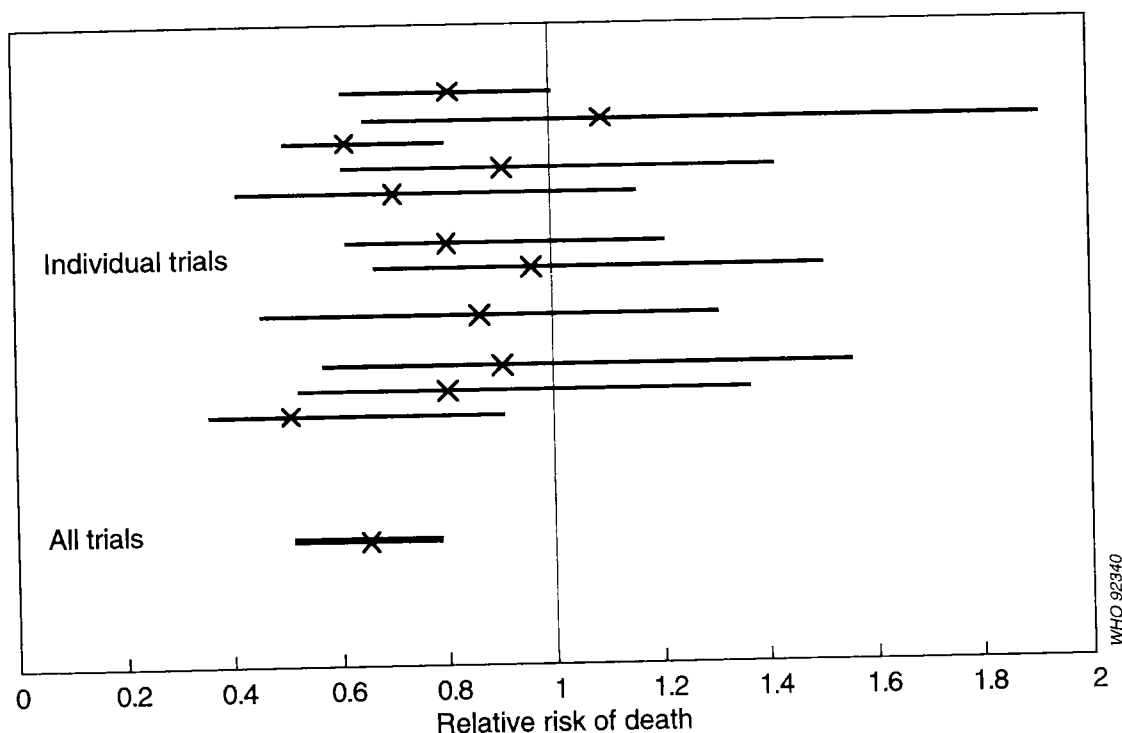
WORLD HEALTH ORGANIZATION

Source: United Kingdom Statistical Service, 1984. Reproduced in *The Quarterly Journal*, 6(3): 10(1984).

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Descriptive ecological time-series data that suggest a cause-effect relationship. Based on our knowledge of traffic accident injuries and the protection afforded by seat-belts, the cause-effect relationship is highly probable. A confounding factor could be involved, however, if other changes in exposure or protection (for example, a lower and enforced speed limit) occurred at the time that the law concerning seat-belts came into force.

Figure 5.5
Meta-analysis of selected randomized trials of
beta-blockers in the prevention of deaths following
a myocardial infarction



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Source: Yusuf et al., 1985. Reproduced by kind permission of the publisher.

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Meta-analysis combines data from more than one study and calculates the means and standard deviations in a more "powerful" way than was possible for each individual study. The bars in the graph show means and confidence intervals for 11 studies. The tendency is for the relative risk of death to be reduced, but the confidence interval in most studies includes the relative risk = 1, which means that a statistically significant reduction of mortality was not shown. When all the studies are combined by meta-analysis (all trials) the mean relative risk is 0.65 and the confidence interval reaches a maximum of 0.8. A clear conclusion about the preventive effect of beta-blockers can then be drawn.

Table 5.2**Percentage of people with hearing loss**

Average noise level during an 8-hour working day (decibels)	Exposure time (years)		
	5	10	40
< 80	0	0	0
85	1	3	10
90	4	10	21
95	7	17	29
100	12	29	41
105	18	42	54
110	26	55	62
115	36	71	64

**WORLD HEALTH ORGANIZATION***Source: WHO, 1980a.*

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Both the noise intensity (decibels) and the duration of noise exposure (years) influence the development of hearing loss. The response is the prevalence of hearing loss (percent) and the table shows how this increases both with noise level and noise exposure duration.

Table 5.3

**Relative ability of different types
of study to "prove" causation**

Type of study	Ability to "prove" causation
Randomized controlled trials	Strong
Cohort studies	Moderate
Case-control studies	Moderate
Cross-sectional studies	Weak
Ecological studies	Weak



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A carefully conducted randomized controlled trial is devoid of bias and confounding and thus the most powerful tool available for demonstrating causation. Nevertheless, the other factors listed in Table 5.1 are equally important when assessing causation based on a study.

Handout 5.1

ACUTE OUTBREAK OF DISEASE AND DEATH ASSOCIATED WITH EXTREME AIR POLLUTION (Based on the London Fog Episode, December 1952)

Background

It is 1952 and you are responsible for Public Health in the Greater London area. On 5 December a thick layer of fog develops at temperatures close to 0 degrees C. The fog persists without remission for several days. The daily newspapers carry stories about the fog. There is general agreement that it is unusually severe.

There is a heavy demand for hospital beds and on 8 December the Central London hospitals issue an Emergency Bed Warning, stating that they have sufficient beds for less than 85% of applicants. In addition, the Veterinary Public Health section of the Ministry of Health has reported that many cattle at the Smithfield show became ill during the fog and had to be slaughtered.

On 8 December the newspapers report that people are dying due to the fog; the reason given is that the fog contains dangerous chemical pollutants. Due to community concern, the Minister of Health appoints you to investigate all health aspects of the fog, to propose remedial measures and to prepare information for the community about the fog.

Questions for discussion

1. What pollutants are of interest in relation to this fog and what are their likely health effects?
2. What types of information would you try to collect for the investigation?
3. How would you estimate whether or not the current increase of morbidity is an "epidemic" and whether or not it is linked to increased mortality?
4. What can you do to alleviate the current situation?
5. How would you organize the information dissemination part of the task?

PAGE 2 OF HANDOUT 5.1

The fog clears on 9 December but the hospital admission rate remains high for another week. Coroners' reports indicate that an unusually high number of sudden deaths occurred during the fog. Inquiries show that there was no influenza epidemic in London during the time of the fog. You decide to start by analysing the deaths that occurred, and have assembled the following table:

Mortality in London: Number of deaths during the period 15th November, 1952 to 10th January, 1953, compared with the average of the corresponding weeks during the preceding five years							
Deaths registered during the week ended							
1952	22 Nov	29 Nov	6 Dec	13 Dec	20 Dec	27 Dec	3 Jan
Greater London (pop. 8,364,000)	1991	1902	2062	4703	3138	2234	2977
Average week 1947-1951	1708	1809	1805	1852	1914	1923	2302
London County	753	853	945	2484	1523	1029	1372

Additional questions

6. Was there an epidemic? What type of statistical test would you use to reach your answer?
7. How many additional people died because of the fog?
8. What type of more detailed information about mortality do you need in order to identify a link with air pollution and to describe the epidemiological aspects of the additional mortality?

PAGE 3 OF HANDOUT 5.1

9. What remedial measures would you suggest to prevent another "fog disease" episode in the future?
10. How would you investigate a similar pollution episode and its health effects in 1990?

Reference: Ministry of Health. Mortality and morbidity during the London fog of December 1952. Reports on public health and medical subjects No. 95. HMSO, London, 1954.

Teacher's notes 5.1

SUGGESTED ANSWERS TO THE LONDON FOG EXERCISE

1. Smoke—TSP
SO₂
NO₂
Others, e.g. CO.
2. Detailed hospital admission date.
Daily mortality records from coroners and registrar of vital statistics.
Data concerning absence due to sickness.
School health data.
Other health data.
Meteorological data.
Air pollution monitoring data (if available).
Air pollution measurements that can be organized rapidly.
Demographic data.
3. Calculate morbidity for the period of the fog and compare with "background morbidity" (for the same area for the week before the fog and for the same area for the preceding year). Calculate mortality for those diseases for which morbidity is increased, in order to see if the same pattern occurs.
4. Advise medical practitioners to treat patients in their homes as much as possible. Strengthen the hospital facilities, maybe with help from the army. Reduce pollution by closing down power stations and/or major industries temporarily. Reduce contributory pollution arising from car use by placing restrictions on car use within the city.
5. Daily press conference and briefings of study team.
6. Yes, definitely, mortality more than doubled during the week of the fog. The increased mortality was similar to that of the influenza epidemic of 1988 or the cholera epidemic of 1854.

PAGE 2 OF TEACHER'S NOTES 5.1

7. During the week of the fog the excess number of deaths was about 2800, if compared with previous years, or 2600 if compared with the previous week. In the week after the fog there was an excess of about 1200 deaths, which could have been an after-effect of the fog. The total number could be 4000.

8. Disease-specific mortality in order to see whether diseases potentially caused by air pollution were increased.

Information on whether the disease started before the fog or during the fog.

Geographic distribution of mortality.

Age/sex-specific mortality data.

9. Emergency measures:

Closing down of industrial emission sources based on meteorological forecast and evidence of rapid pollution increase.

Immediate public health warnings broadcast on radio and TV.

Ban on automotive traffic in downtown area or alternative driving privileges (odd/even).

Switch to natural gas for power production.

Preventive measures:

Ban use of coal for domestic heating.

Institute flue gas desulfurization for major industries.

10. Perform a longitudinal study of pollution and mortality in the community covering the periods before, during and after the episode.

7.6 Chapter 6 resources

Learning objectives overhead

Overhead explanations

Overhead 6.1	Primordial prevention
Overhead 6.2	Primary prevention
Overhead 6.3	Primary prevention: the population strategy
Overhead 6.4	Primary prevention: the high-risk strategy
Overhead 6.5	Prevention paradox
Overhead 6.6	Secondary prevention, tertiary prevention
Overhead 6.7	Screening

Overhead tables and figures from *Basic Epidemiology*

Figure 6.1	Age-standardized death rates from tuberculosis in England and Wales, 1840–1968
Figure 6.2	Changes in contribution of chronic and infectious conditions to total mortality in the United States, 1900–1973
Table 6.1	Levels of prevention
Figure 6.3	Summary of annual sulfur dioxide levels in selected cities
Figure 6.4	Change in total consumption of manufactured cigarettes in six areas, 1970–1985
Figure 6.5	Relationship between serum cholesterol (histogram) and mortality from coronary heart disease (interrupted line) in men aged 55–64 years
Figure 6.6	Distribution of cholesterol levels in Japan and Finland
Figure 6.7	Targets for population mean serum cholesterol levels
Table 6.2	Advantages and disadvantages of strategies for primary prevention
Figure 6.8	Relationship between decrease in death rates from cancer of the cervix between 1960–62 and 1970–72 and population screening rates in several Canadian provinces
Table 6.3	Criteria for instituting a screening programme
Table 6.4	Validity of a screening test

Table 6.5

Breast cancer mortality rates at different times after the start of the follow-up among women receiving screening (mammography) and controls

Learning Objectives: Chapter 6

- 1. Relate the different stages of the development of a disease to the phases of prevention.**
- 2. Describe the advantages and disadvantages of population and high-risk prevention strategies.**
- 3. Understand the role and limitations of screening regarding the early detection of disease.**



Overhead 6.1

PRIMORDIAL PREVENTION

**Prevention of the emergence of
living patterns that contribute
to increased risk of disease
(e.g. maintenance of low-fat
diet in Asian countries).**



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Overhead 6.2

PRIMARY PREVENTION

**Prevention of disease by
controlling risk factors
(e.g. non-smoking promotion).**

STRATEGIES:

Population

High-risk



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Overhead 6.3

PRIMARY PREVENTION:

The Population Strategy

Advantages:

- **radical**
- **large potential for population**
- **behaviourally appropriate**

Disadvantages:

- **small benefits to individuals**
- **poor motivation of subject**
- **poor motivation of physician**
- **benefit-to-risk ratio may be low**



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PRIMARY PREVENTION:

The High-risk Strategy

Advantages:

- appropriate to individuals
- subject motivation
- physician motivation
- benefit-to-risk ratio is favourable

Disadvantages:

- high screening costs
- temporary effect
- limited effect
- behaviourally inappropriate



PREVENTION PARADOX

**"A preventive measure which brings
much benefit to the population often offers
little to each participating individual."**

(Rose, 1985)



SECONDARY PREVENTION

**Reduction in consequences of disease by early
diagnosis and treatment
(e.g. cervical cancer screening).**

TERTIARY PREVENTION

**Reduction of complications of disease
(e.g. MV crashes and ICU).**



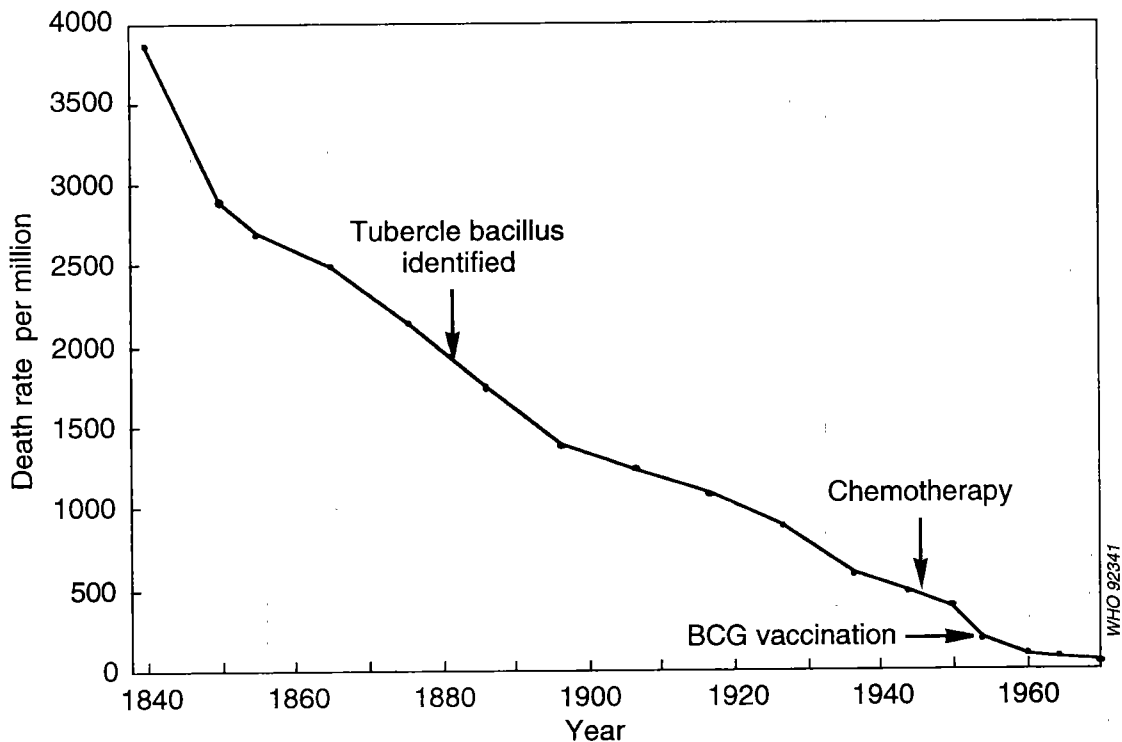
Overhead 6.7

SCREENING

The organized attempt to detect, among apparently healthy people in the community, disorders or risk factors of which they are unaware.



Figure 6.1
Age-standardized death rates from tuberculosis in
England and Wales, 1840–1968



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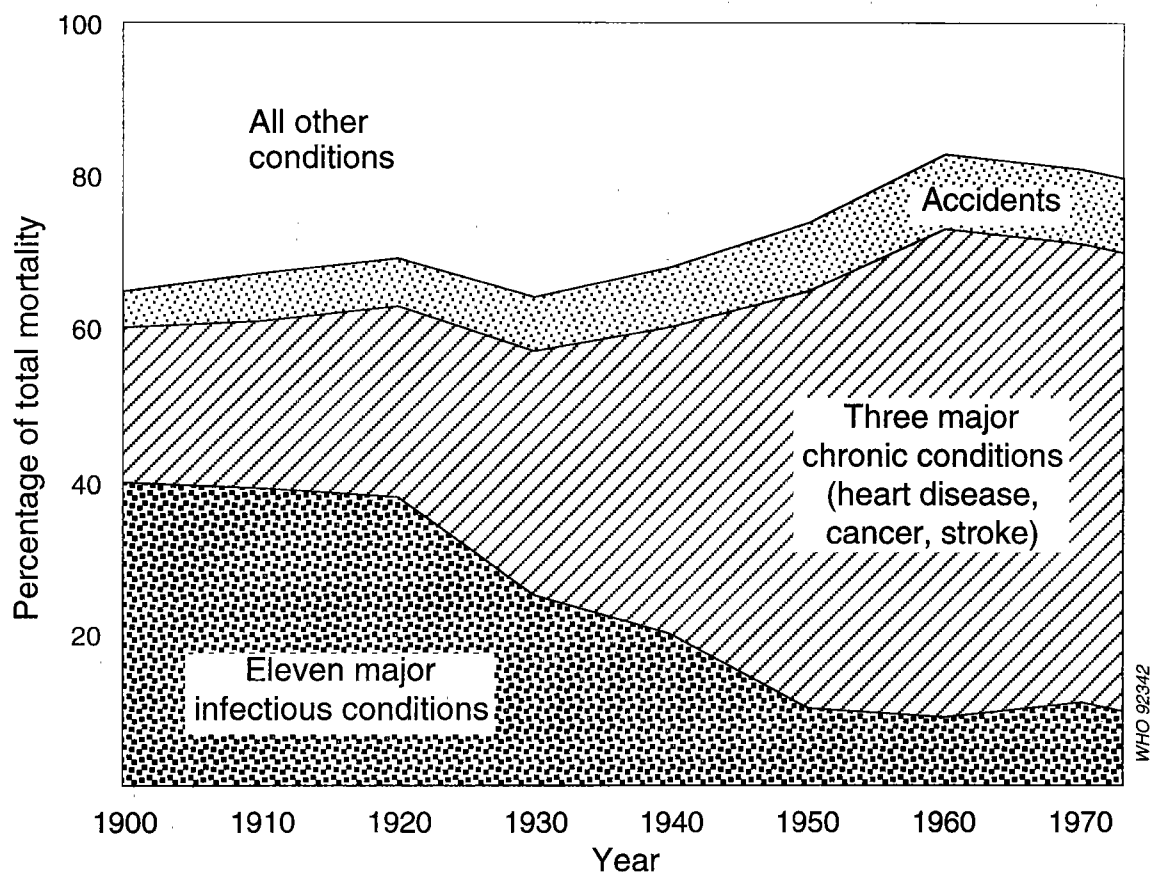
Source: McKeown, 1976. Reproduced by kind permission of the publisher

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In industrialized countries, tuberculosis mortality rates have fallen dramatically during the past 100 years due to preventive measures. Among these, general improvements in housing and nutrition have had the most significant impact. Drug treatment, on the other hand, has had a comparatively late and minor impact. For some developing countries, current tuberculosis mortality rates are similar to those experienced by Europe in the 19th Century. In fact, in developing countries, faltering public health programmes, poverty and AIDS are contributing to an increase in tuberculosis incidence.

Figure 6.2

Changes in contribution of chronic and infectious conditions to total mortality in the United States, 1900-1973



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Source: McKinlay et al., 1989. Reproduced by kind permission of the publisher.

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The proportional mortality expressed in this graph changes over time. With the decline in infectious diseases, major chronic diseases have automatically assumed greater relative importance. Changing population structure (e.g. a greater percentage of older people) is an important factor. The relative increase in chronic disease mortality reflects the disease panorama as presented to health authorities, but not the individual's risk of dying from a particular disease. To show the latter, age-standardized death rates or cumulative risk measures would have to be calculated.

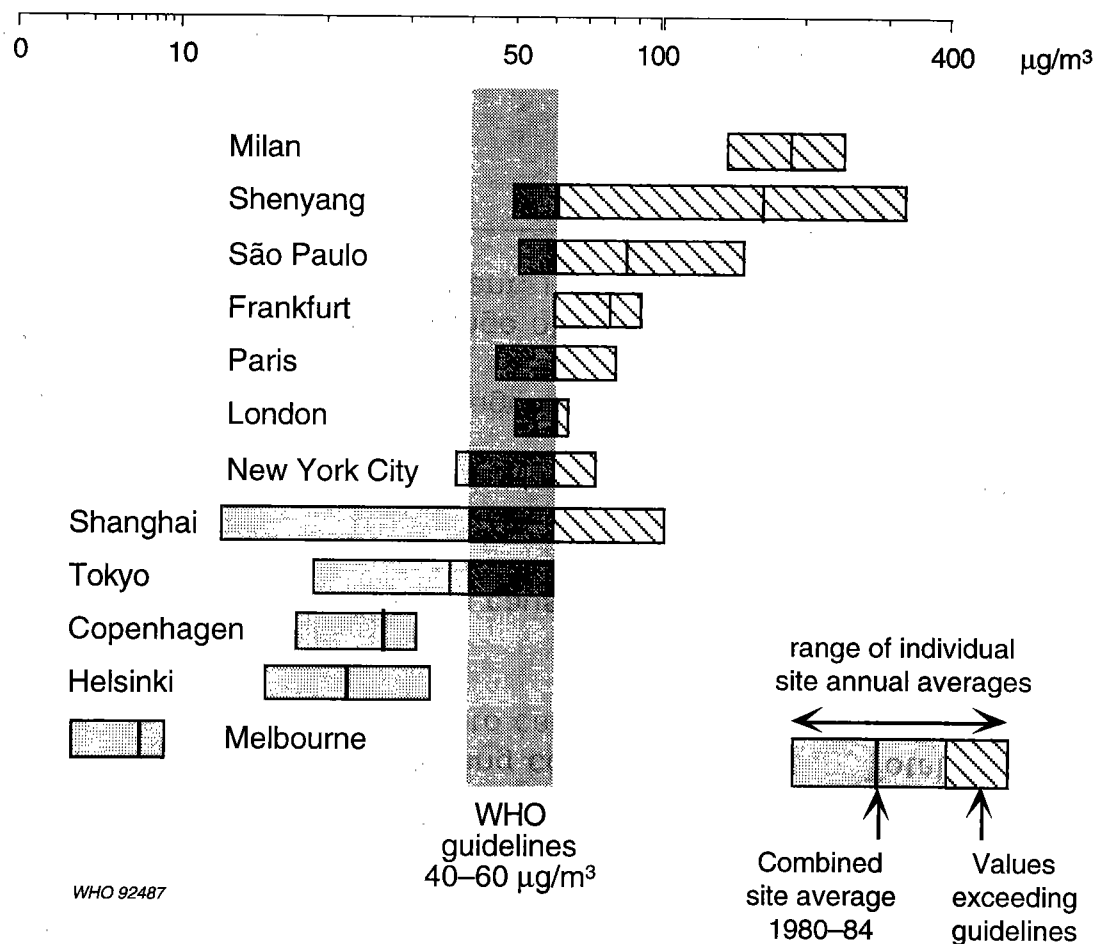
Table 6.1
Levels of prevention

Level of prevention	Phase of disease	Target
Primordial	Underlying conditions leading to causation	Total population and selected groups
Primary	Specific causal factors	Total population, selected groups and healthy individuals
Secondary	Early stage of disease	Patients
Tertiary	Late stage of disease (treatment, rehabilitation)	Patients



A healthy population can be achieved only if all levels of prevention are applied in an appropriate way. Primordial and primary prevention can prevent initiation of the disease process. However, since disease is more easily prevented in young than in old people, the proportion of the population that succumbs to natural aging processes and develops disease will increase. Secondary and tertiary prevention will facilitate modification of the disease process at an early stage and ensure a better quality of life for those living with an incurable disease.

Figure 6.3
Summary of annual sulfur dioxide levels in selected cities



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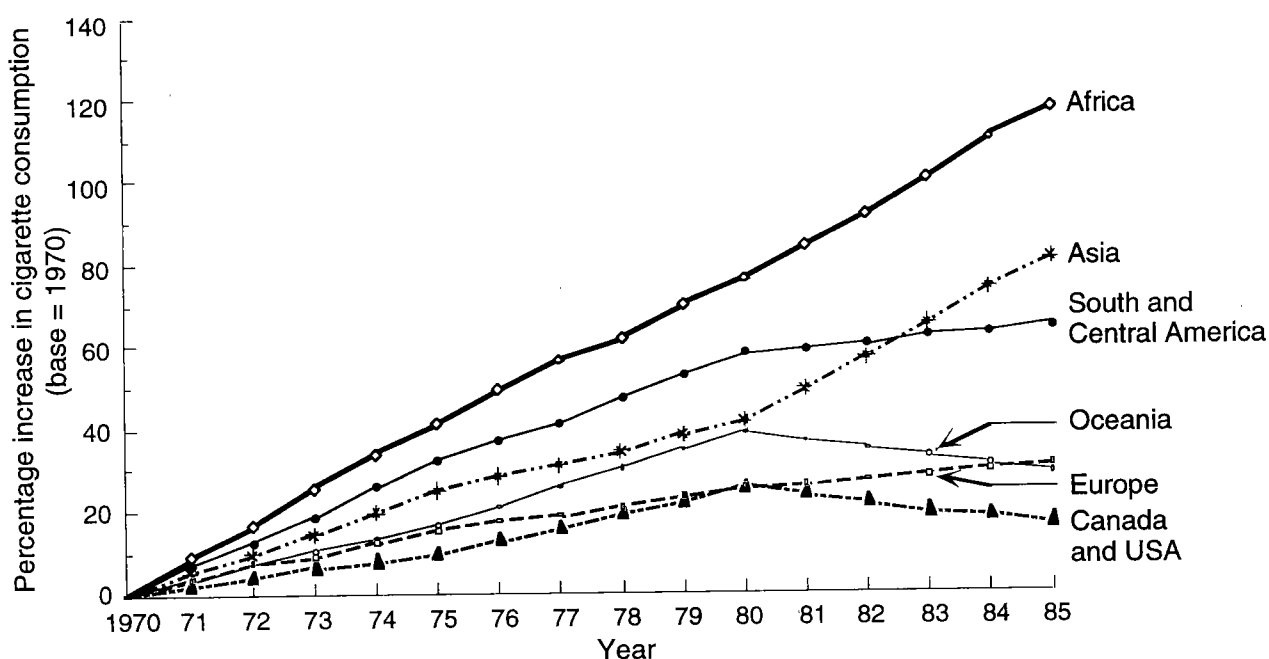
Source: WHO/UNEP, 1988.

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High levels of sulfur dioxide in the air can contribute to lung and heart diseases. This pollutant is emitted principally by power stations and heavy industry after coal burning. It can be reduced by switching to other energy sources and improving the efficiency of burning processes and pollution control devices. Encouraging such improvements through use of economic, legal or other instruments is a common example of primordial prevention.

Figure 6.4

**Change in total consumption of manufactured cigarettes
in six areas, 1970–1985**



WHO 92488



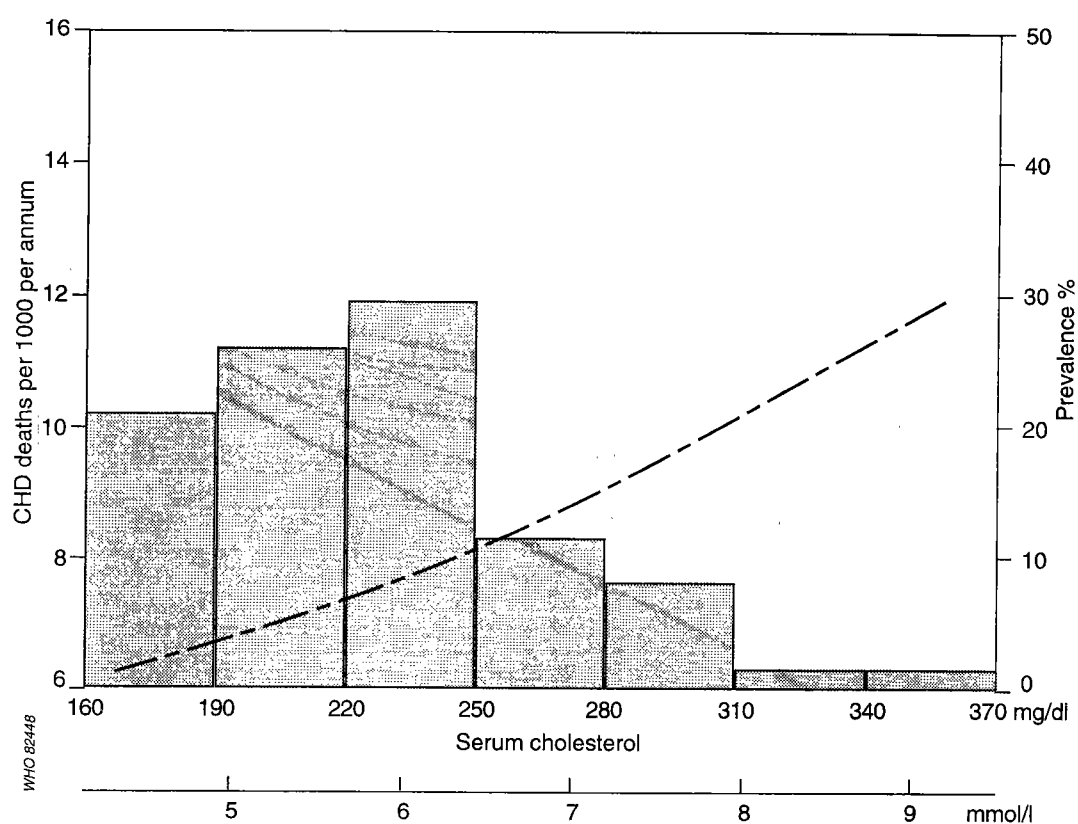
WORLD HEALTH ORGANIZATION

Source: Masironi & Rothwell, 1988.

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Although the level of tobacco smoking has evened out, or fallen, in developed countries, the curves are rising rapidly in many developing countries. Tobacco companies are investing heavily to encourage tobacco smoking in the latter, and public health authorities are often powerless to prevent them. Effective primordial prevention against the serious health impact of tobacco smoking — the latter will become evident in developing countries over the next 30 years — would involve using every available means, including bans on tobacco advertising and tobacco farming and high taxes on any tobacco offered for sale, to discourage tobacco smoking in these countries.

Figure 6.5
Relationship between serum cholesterol (histogram)
and mortality from coronary heart disease (interrupted line)
in men aged 55–64 years



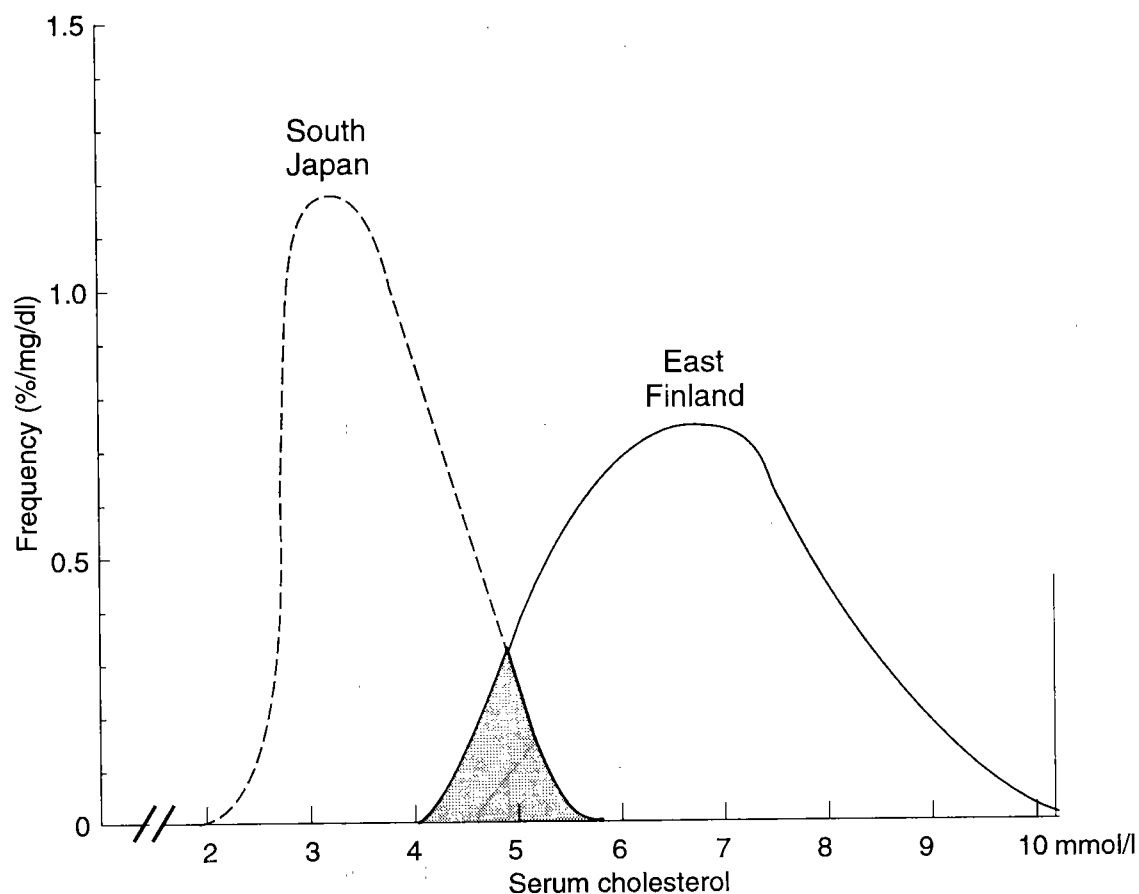
WORLD HEALTH ORGANIZATION

Source: WHO, 1982.

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Mortality due to coronary heart disease (CHD) rises with increasing serum cholesterol as represented by the interrupted line, which shows 6/1000 for those with a serum cholesterol level of 5 mmol/l, and 12/1000 for those with a serum cholesterol level of 9 mmol/l. However, in a typical population the distribution of serum cholesterol is skewed (see histogram) so that the cholesterol level of about 80% of the population is below 6.5 mmol/l. Most cases of death due to cholesterol-related heart disease occur in the mid-range of cholesterol levels. Primary prevention should therefore be targeted at people with the highest cholesterol levels, and the population as a whole.

Figure 6.6
Distribution of cholesterol levels in Japan and Finland



WHO 92489



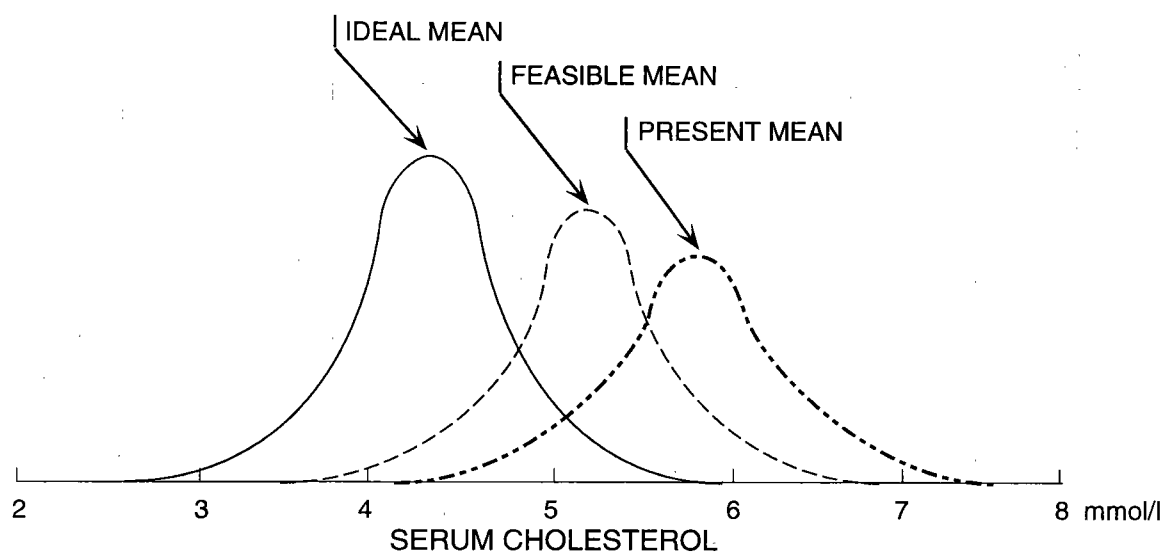
WORLD HEALTH ORGANIZATION

Source: WHO, 1982.

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Different "normal" populations have quite different distributions of serum cholesterol levels. Shifting the levels of an entire population by primordial prevention, by promoting changes in diet for example, would contribute significantly to the prevention of coronary heart disease. Reducing individual levels by diet or drug therapy would be examples of primary prevention.

Figure 6.7
Targets for population mean serum cholesterol levels



WHO 92490



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Source: WHO, 1982.

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The targets for the prevention of cholesterol-related heart disease have been set in the form of population distributions of serum cholesterol levels. Those countries that have, on average, low levels of serum cholesterol should implement nutrition policies that discourage adoption of the diet of western developed countries, in order to help avoid creating a cholesterol problem for the future.

Table 6.2

**Advantages and disadvantages of strategies
for primary prevention**

Population strategy	High-risk individual strategy
Advantages	
<ul style="list-style-type: none"> • Radical • Large potential for whole population • Behaviourally appropriate 	<ul style="list-style-type: none"> • Appropriate to individuals • Subject motivation • Physician motivation • Favourable benefit-to-risk ratio
Disadvantages	
<ul style="list-style-type: none"> • Small benefit to individuals • Poor motivation of subject • Poor motivation of physician • Benefit-to-risk ratio may be low 	<ul style="list-style-type: none"> • Difficulties identifying high-risk individuals • Temporary effect • Limited effect • Behaviourally inappropriate



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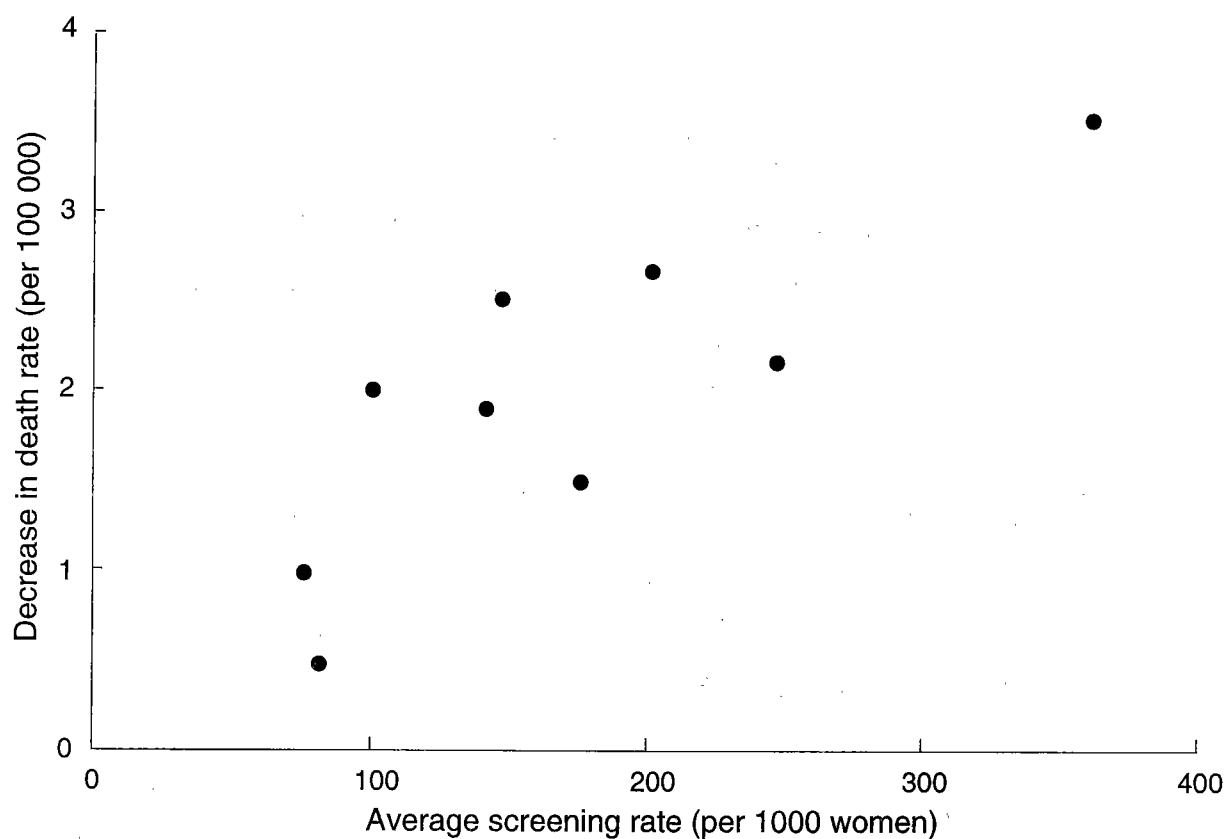
Adapted from Rose, 1985.

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Depending on the disease being prevented and the local conditions, these advantages and disadvantages may play a greater or lesser role. A local example could be used in a discussion with the students to highlight the importance of the different factors pertaining to your country.

Figure 6.8

Relationship between decrease in death rates from cancer of the cervix between 1960-62 and 1970-72 and population screening rates in several Canadian provinces



WHO 92491



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Source: Boyes et al., 1977. Reproduced by kind permission of the publisher

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In this instance, the association between the proportion of women screened for cervical cancer and the cervical cancer mortality rate illustrates a successful secondary prevention programme, since all the women identified with cervical cancer have ready access to treatment. In countries with poorly developed medical services, secondary prevention of this type may not be so successful.

Table 6.3

Criteria for instituting a screening programme

Disease	Serious
	High prevalence of preclinical stage
	Natural history understood
	Long period between first signs and overt disease
Diagnostic test	Sensitive and specific
	Simple and cheap
	Safe and acceptable
	Reliable
Diagnosis and treatment	Facilities are adequate
	Effective, acceptable, and safe treatment available



WORLD HEALTH ORGANIZATION

Among these criteria for decisions concerning a screening programme, available diagnosis and treatment facilities may be the most important. Try to find examples from your country of screening programmes that would be recommended and those that would not be recommended in the current circumstances.

Table 6.4
Validity of a screening test

	Disease status		Total
	Present	Absent	
Screening test	Positive	a b	$a + b$
	Negative	c d	$c + d$
Total	$a + c$	$b + d$	$a + b + c + d$

KEY:

a = number of true positives
 b = number of false positives

c = number of false negatives
 d = number of true negatives

Sensitivity = probability of a positive test in people with the disease
= $a / (a + c)$

Specificity = probability of a negative test in people without the disease
= $d / (b + d)$

Positive predictive value = probability of the person having the disease when the test is positive
= $a / (a + b)$

Negative predictive value = probability of the person not having the disease when the test is negative
= $d / (c + d)$



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Sensitivity and specificity are fundamental issues in diagnostic testing. Ideally, all biochemical, physiological, clinical tests and questionnaires should be evaluated for validity before the epidemiological study begins.

Table 6.5

**Breast cancer mortality rates at different times after
the start of the follow-up among women receiving
screening (mammography) and controls**

	No. of women with breast cancer	No. of deaths (from start of follow-up)		
		5 years	10 years	18 years
Screened group	307	39	95	126
Control group	310	63	133	163
% difference		38.1	28.6	22.7



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Source: Shapiro, 1989.

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Reduced mortality in breast cancer as a result of screening and early treatment. Five years after diagnosis, one-third of the patients who would have died without screening had survived. The proportion surviving declines with follow-up time, but this may reflect the increasing elderliness of the group or the increasing prominence of death due to other causes. After 100 years of follow-up all the patients would of course be dead.

7.7 Chapter 7 resources

The main resource for Chapter 7 is a problem-solving exercise based on material prepared by Dr. J. Sturt of the Gloucester Health Authority (Handout 7.1).

Learning objectives overhead

Overhead tables and figures from *Basic Epidemiology*

Figure 7.1	Kaposi sarcoma in New York
Figure 7.2	Outbreak of cholera, London, August–September 1854
Figure 7.3	Measles epidemic in children on a small island
Table 7.1	Deaths from smallpox in selected European countries, 1900–1919
Figure 7.4	The spectrum of illness from communicable disease
Table 7.2	Methods of transmission of an infectious agent

Handout and teacher's notes

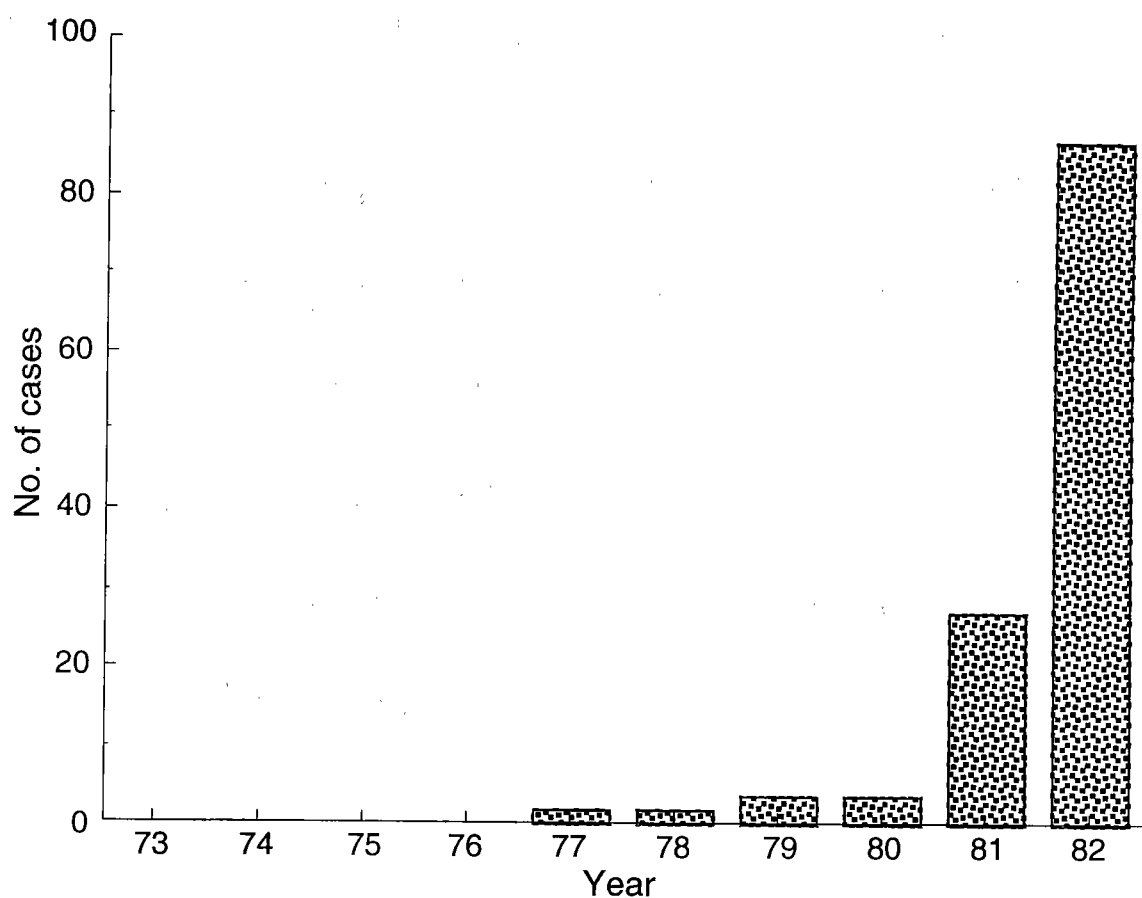
Handout 7.1	Meningitis in Gloucestershire
Teacher's notes 7.1	Suggested answers to meningitis in Gloucestershire

Learning Objectives: Chapter 7

- 1. Understand the contribution of epidemiology to the prevention of communicable diseases.**
- 2. Outline ways of investigating the chain of infection that is common to all epidemics.**
- 3. Describe the steps that should be taken when investigating and attempting to control a communicable disease epidemic.**



Figure 7.1
Kaposi sarcoma in New York



WHO 92492



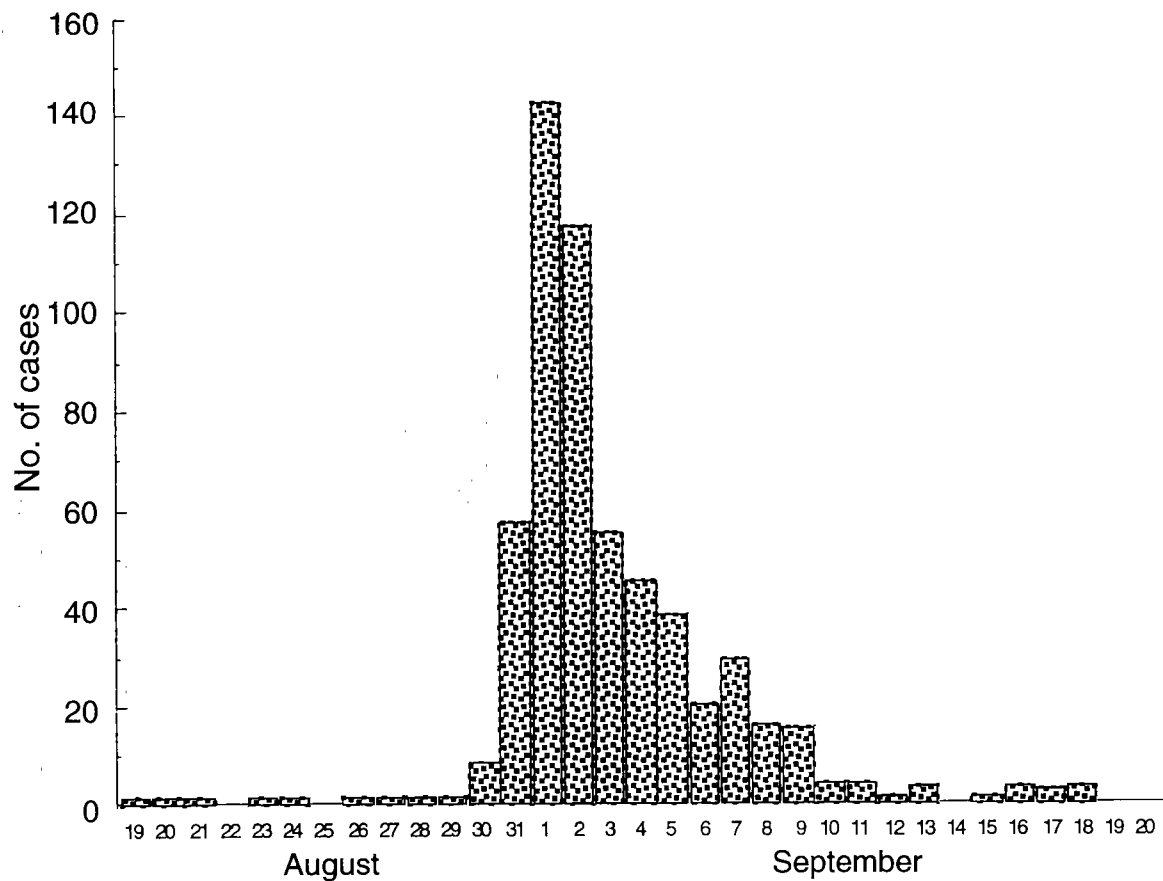
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Source: Biggar et al., 1988. Reproduced by kind permission of the publisher.

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Rapid increase in occurrence of Kaposi sarcoma in New York due to the increasing prevalence of AIDS. An epidemic has begun.

Figure 7.2
Outbreak of cholera, London, August–September 1854



WHO 92493



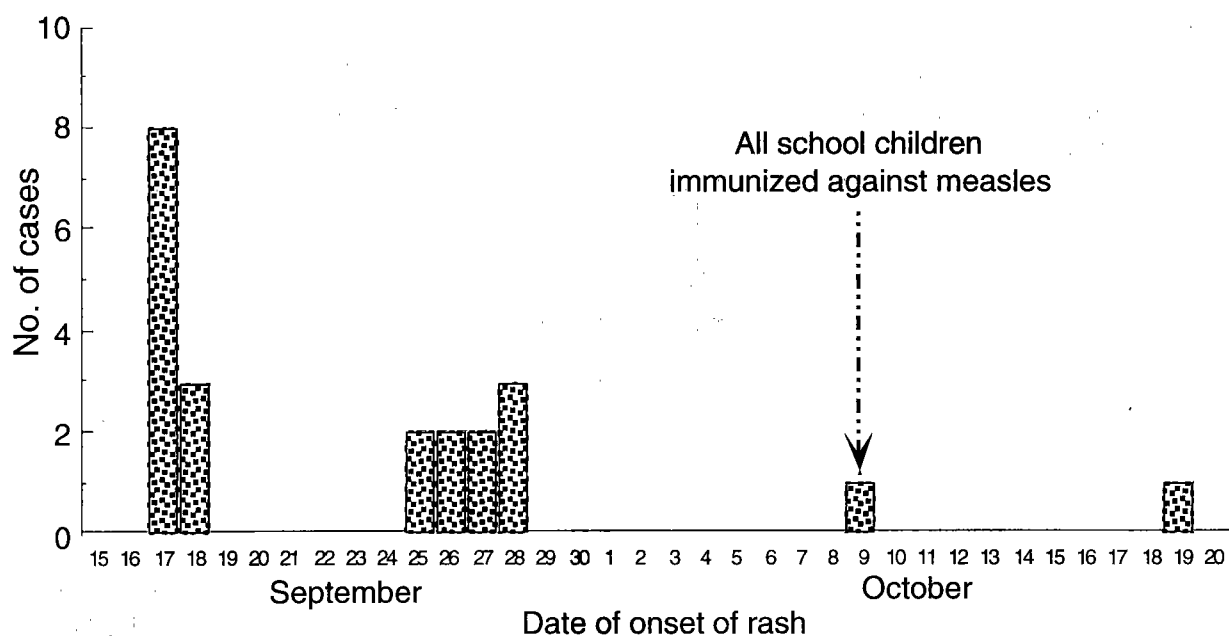
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Source: Snow, 1855.

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The 1854 cholera epidemic in London, studied by Snow. The epidemic lasted about one week. It has been debated whether or not the removal of the pump-handle on the offending drinking-water source influenced the course of the epidemic.

Figure 7.3
Measles epidemic in children on a small island



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Source: Gao & Malison, 1988. Reproduced by kind permission of the publisher.

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A more slowly developing epidemic — this one of measles — which was halted almost completely by immunizing the children at risk. The spread over time of the cases may indicate spread from person to person, and contrasts with the cholera epidemic in London in which all those at risk were probably exposed to the cause of the disease at the same time.

Table 7.1
Deaths from smallpox in selected
European countries,
1900–1919

	1918 population (millions)	Number of reported deaths			
		1900–04	1905–09	1910–14	1915–19
Finland	3	295	155	182	1 605
Germany	65	165	231	136	1 323
Italy	34	18 590	2 149	8 773	17 453
Russia	134	218 000	221 000	200 000	535 000 ^a

^a includes non-fatal cases.



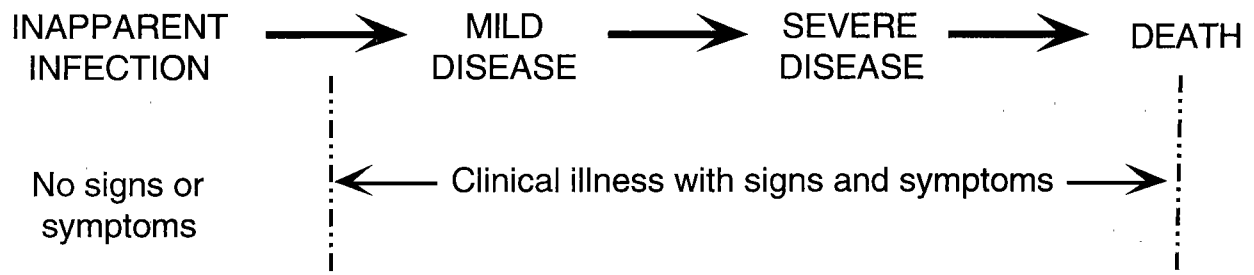
WORLD HEALTH ORGANIZATION

Source: Fenner et al., 1988.

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Smallpox mortality increased dramatically during the First World War (1914–18) due to poor hygienic conditions and the spread of poverty. Epidemics of communicable diseases have also been a devastating feature of the recent wars in Yugoslavia, Somalia, Sudan, etc.

Figure 7.4
The spectrum of illness from
communicable disease



WHO 92495



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The range of severity of illness and infection in a case of communicable disease. Some people with inapparent infections become “carriers”, which means that they spread the disease to others without being clinically ill themselves.

Table 7.2

Methods of transmission of an infectious agent

Direct transmission:

Touching

Kissing

Sexual intercourse

Other contact (e.g. childbirth, medical procedures, injection of drugs, breast-feeding)

Airborne, short-distance (via droplets, coughing, sneezing)

Transfusion (blood)

Transplacental

Indirect transmission:

Vehicle-borne (contaminated food, water, towels, farm tools, etc.)

Vector-borne (insects, animals)

Airborne, long-distance, (dust, droplets)

Parenteral (injections with contaminated syringes)



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The routes of infection vary for different viruses and bacteria. Generally there are one or two main methods of transmission; no infectious agent can transmit via all the methods in the table. A detailed knowledge of these transmission routes is required for effective primary prevention.

Handout 7.1

MENINGITIS IN GLOUCESTERSHIRE

Background

Meningococcal infections are caused by a bacteria called *Neisseria meningitides*. The bacteria are spread from person to person by droplets and enter the body via the nose and pharynx. In some people the bacteria remain in the nose and pharynx without producing any clinical manifestations. These people are called "carriers". In other people the organism may enter the blood stream, producing fever, skin rashes and meningitis. This can result in severe illness causing death.

When a doctor first diagnoses or even suspects a case of meningococcal infection, he or she is required to notify the case to the District Medical Officer. There is a list of some 26 infectious diseases that have to be notified. These notifications are used to inform us about the occurrence of these diseases. But for various reasons, not all cases are in practice notified.

The following table provides data on deaths from meningococcal infection and notifications of meningococcal meningitis in England and Wales for the period 1973–1985. Assuming that the proportion of cases notified remains constant from 1973 to 1985, what would your comments be concerning any trend in the severity of this disease? What are the reasons for your conclusions?

**Deaths from meningococcal infection and notifications of
meningococcal meningitis in England and Wales for the period 1973–1985**

Year	Deaths	Notification	Year	Deaths	Notification
1973	205	1067	1980	71	509
1974	226	1296	1981	85	464
1975	156	864	1982	70	410
1976	133	718	1983	70	428
1977	82	500	1984	70	401
1978	96	501	1985	94	549
1979	97	525			

Teacher's notes 7.1

SUGGESTED ANSWERS TO MENINGITIS IN GLOUCESTERSHIRE

- It is possible to calculate a crude index of case-fatality, which is one measure of severity. In this case it would range from 19.7% to 14.0%. However, this may be grossly inflated by under-notification, and meningococcal meningitis will exclude other cases of meningococcal infection.
- Disease maintains its severity in spite of probable improvements in clinical management.
- Cases may present themselves or be diagnosed too late for treatment to be effective.

7.8 Chapter 8 resources

Learning objectives overhead

Overhead explanations

Overhead 8.1	Clinical epidemiology
Overhead 8.2	Definitions of normality and abnormality
Overhead 8.3	Diagnostic tests
Overhead 8.4	Natural history and prognosis
Overhead 8.5	Effectiveness of treatment
Overhead 8.6	Prevention in clinical practice

Overhead tables and figures from *Basic Epidemiology*

Figure 8.1	Percentage distribution of serum cholesterol (mmol/l) in men aged 50–62 who did or did not subsequently develop coronary heart disease
Figure 8.2	Treatment of hypertension: changing definition of recommended treatment level over time
Figure 8.3	Relationship between a diagnostic test result and the occurrence of disease
Figure 8.4	Survival following myocardial infarction, Auckland, 1974 and 1981
Figure 8.5	Self-reporting of stopping smoking at one year follow-up

Learning Objectives: Chapter 8

- 1. Demonstrate the contribution of epidemiology to clinical practice.**
- 2. Describe approaches to establishing "normality".**
- 3. Outline the role of epidemiology in describing the natural history of a disease.**



Overhead 8.1

CLINICAL EPIDEMIOLOGY

Clinical epidemiology is the application of epidemiological principles and methods to the practice of clinical medicine.

Clinical epidemiology is concerned with:

- **definitions of normality and abnormality**
- **accuracy of diagnostic tests**
- **natural history and prognosis**
- **effectiveness of treatment and prevention.**



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DEFINITIONS OF NORMALITY AND ABNORMALITY:

- Normal as common
- Abnormal as associated
with disease
- Abnormal as treatable



Overhead 8.3

DIAGNOSTIC TESTS

Of major concern is the *accuracy* of a test ...
its:

- sensitivity
- specificity
- positive predictive value
- negative predictive value



NATURAL HISTORY AND PROGNOSIS

HISTORY — Stages of disease:

- **pathological onset**
- **presymptomatic stage**
- **clinical stage**

PROGNOSIS — Prediction of the future course of the disease following its onset:

- **case finding**
- **survival**



Overhead 8.5

EFFECTIVENESS OF TREATMENT

EFFICACIOUS: An intervention is efficacious if it does more good than harm in patients who use it.

EFFECTIVE: An intervention is effective if it does more good than harm in those patients to whom it is offered.



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PREVENTION IN CLINICAL PRACTICE

PRIMARY: child immunization

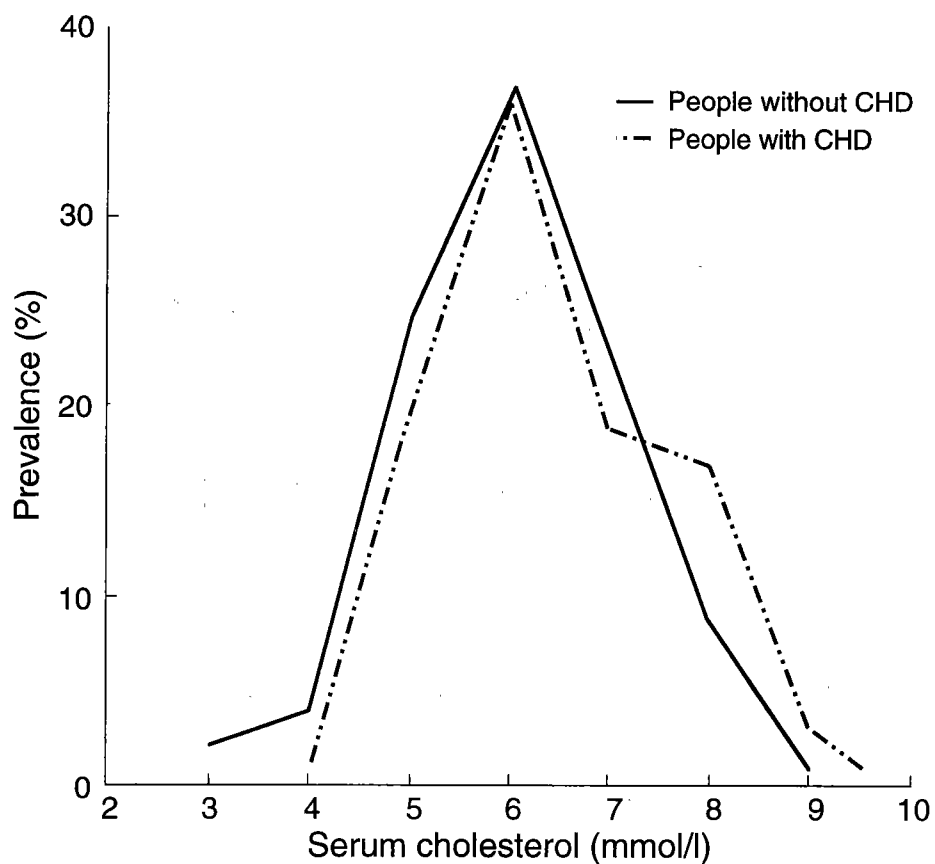
SECONDARY: screening for cancer

TERTIARY: rehabilitation
after stroke



Figure 8.1

Percentage distribution of serum cholesterol levels (mmol/l) in men aged 50–62 who did or did not subsequently develop coronary heart disease



WHO 92496



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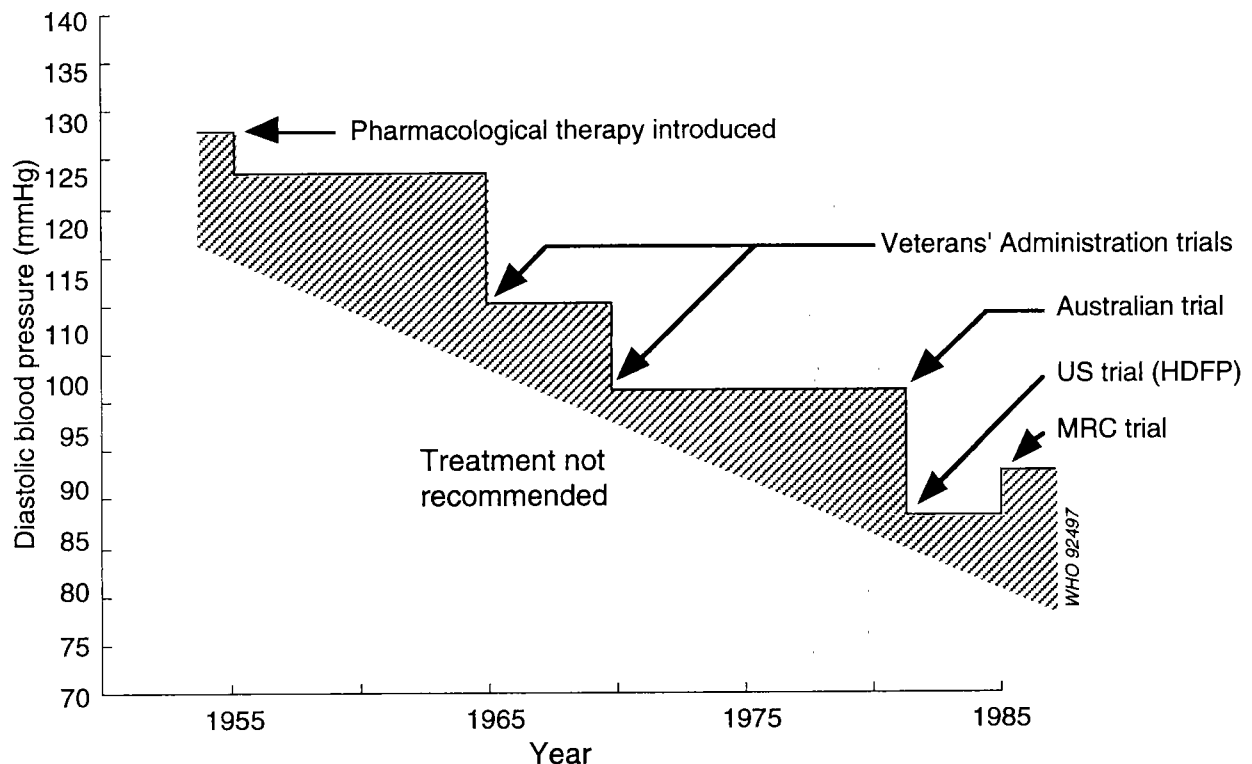
Source: Rose, 1985. Reproduced by kind permission of the publisher.

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The frequency distributions of serum cholesterol show a slight shift towards higher values in patients with coronary heart disease (CHD). Even though high serum cholesterol is associated with CHD, the levels of the majority of patients are in the same range as those of non-patients.

Figure 8.2

Treatment of hypertension: changing definition of recommended treatment level over time



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As epidemiological studies have provided more detailed data about the distributions of blood pressure levels in the general population, and the associations between raised blood pressure and cardiovascular and cerebrovascular diseases, the cut-off levels for treatment to reduce blood pressure have been revised downwards.

Figure 8.3

Relationship between a diagnostic test result and the occurrence of disease

		DISEASE	
		Present	Absent
TEST	Positive	True Positive	False Positive
	Negative	False Negative	True Negative

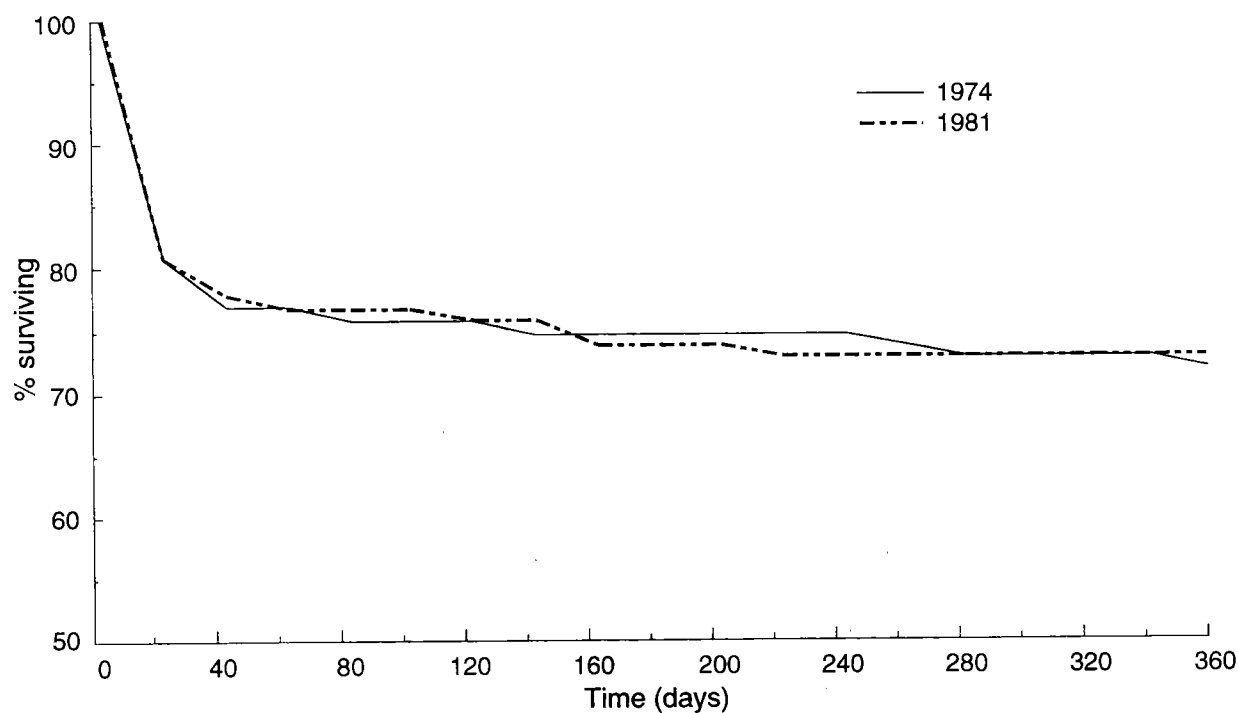
WHO 92498



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Diagnostic tests should produce as few false positive and false negative readings as possible. A test with few false positives has a high specificity, and a test with few false negatives has a high sensitivity (see Table 6.4).

Figure 8.4
Survival following myocardial infarction, Auckland,
1974 and 1981



WHO 92500



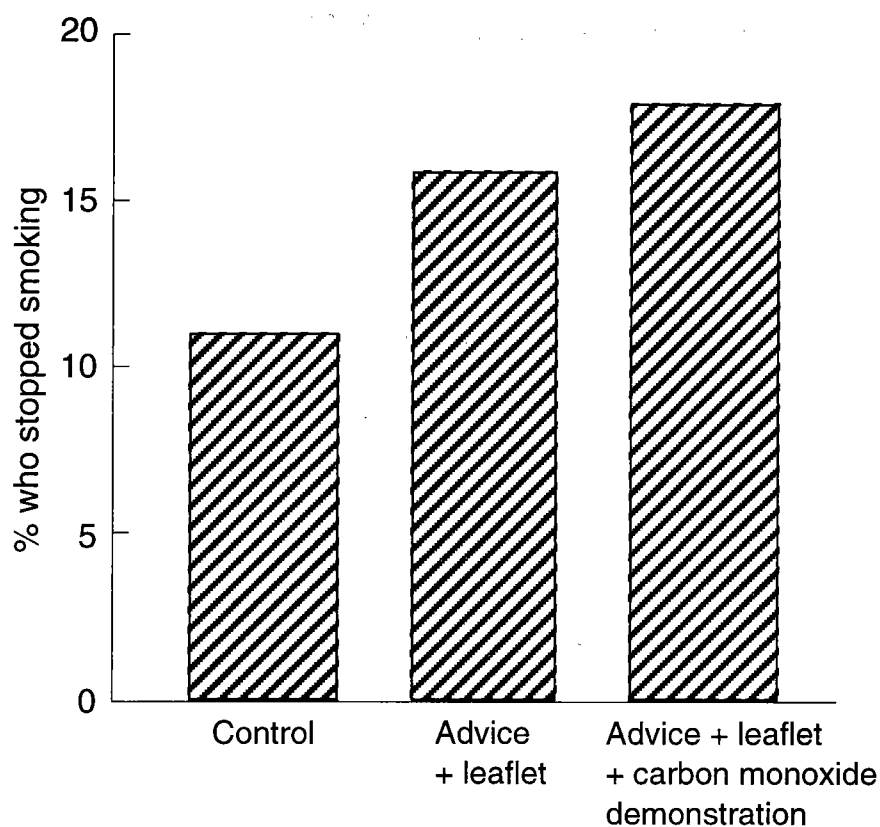
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Source: Stewart et al., 1984. Reproduced by kind permission of the publisher.

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The prognosis in terms of death for cases of myocardial infarction was very similar in the two studies irrespective of secondary prevention efforts.

Figure 8.5
Self-reporting of stopping smoking at one year follow-up



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Source: Jamrozik et al., 1984. Reproduced by kind permission of the publisher.

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Primary prevention efforts in a practice setting and aimed at persuading patients to give up tobacco smoking can be strengthened by combining different methods in order to get the message across.

7.9 Chapter 9 resources

Learning objectives overhead

Overhead explanations

Overhead 9.1	Linking exposure and effects
Overhead 9.2	Special features of environmental and occupational epidemiology

Overhead tables and figures from *Basic Epidemiology*

Figure 9.1	Environmental factors that may affect health
Table 9.1	Blood lead levels at which no more than 5% of the population will show the indicated intensity of effect
Figure 9.2	Individual characteristics that modify the effect of environmental factors
Figure 9.3	The London smog epidemic, December 1952
Figure 9.4	Relationship between asbestos exposure and relative risk of lung cancer
Figure 9.5	Blood and urine levels of cadmium during the first year of occupational exposure
Figure 9.6	Relationship between cadmium dose and urine cadmium
Figure 9.7	Cumulative distribution of blood lead in black children in New York City, 1971 and 1976
Table 9.2	Full-scale and subtest scores on the Wechsler Intelligence Scale for Children (Revised) (WISC-R) for subjects with high and low lead levels in teeth
Figure 9.8	Dose-effect relationship
Figure 9.9	Dose-response relationship
Figure 9.10	Relationship between driving speed, seat-belt use, and frequency of injury in motor car drivers involved in collisions

Learning Objectives: Chapter 9

- 1. Outline how epidemiology can be used to identify associations between environmental factors and health status.**
- 2. Describe the concepts of "exposure" and "dose" as applied in environmental and occupational epidemiology.**
- 3. Understand the special features of environmental and occupational epidemiology.**



LINKING EXPOSURE AND EFFECTS

Exposure, dose:

- **Exposure duration**
- **Exposure level**
- **External and internal dose**

Effects

Response

Dose–effect relationship

Dose–response relationship

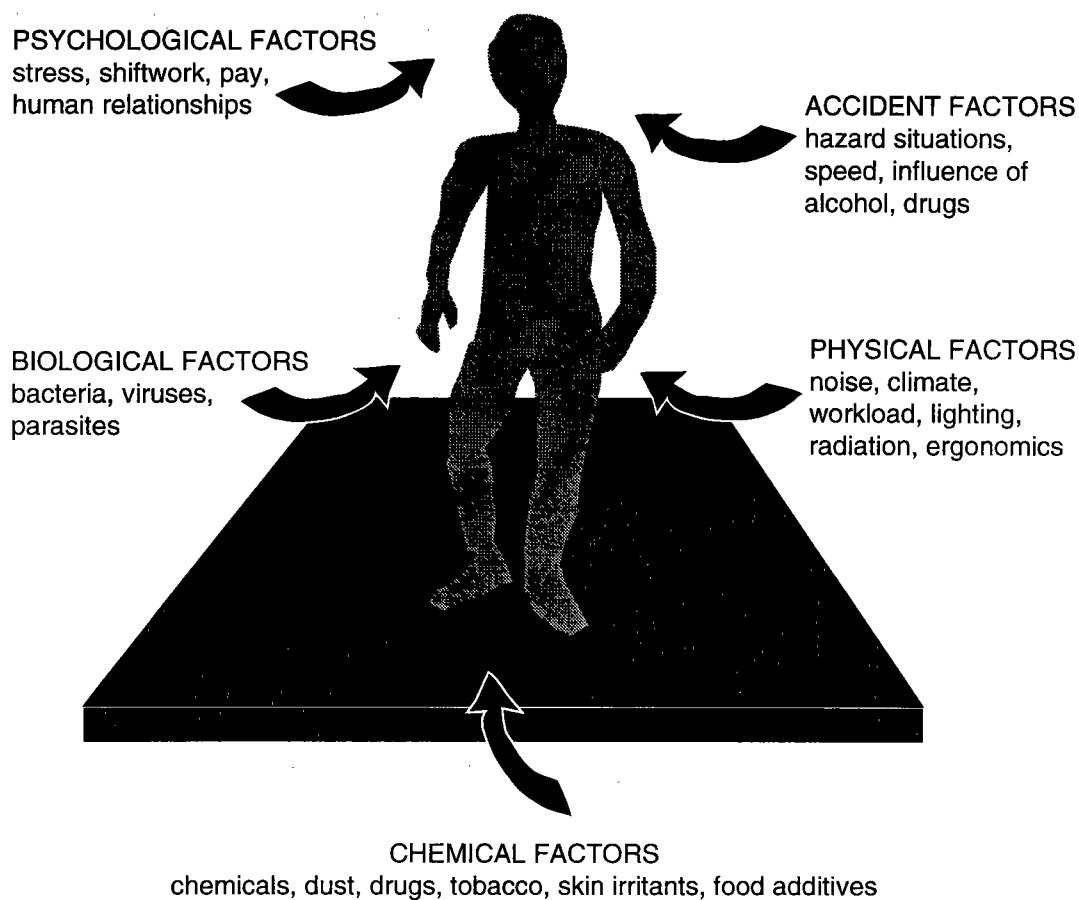


SPECIAL FEATURES OF ENVIRONMENTAL and OCCUPATIONAL EPIDEMIOLOGY:

- **Use of company "rosters"
and other exposure data**
- **Establishment of safety
standards**
- **Healthy-worker effect**
- **Accident and injury
epidemiology**



Figure 9.1
Environmental factors that may affect health



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Five major groups of environmental factors can affect health. Some of these occur only in the workplace environment, while others occur only in the general environment. Combined exposures often create special challenges in epidemiological analysis. Socio-economic and life-style factors interact with the factors in the figure, or are underlying factors, creating a sequential causal route rather than a simple cause-effect relationship.

Table 9.1

**Blood lead levels at which no more than
5% of the population will show the indicated
intensity of effect**

Biochemical effect ^a	Intensity of effect	Population	Blood lead level (μg/l)
ALAD inhibition in red blood cells	> 70% inhibition	adults children	300 250-300
ALA in urine	> 10mg/litre	adults + children	500
FEP in red blood cells	perceptible increase	adult males adult females children	300 250 200

^aALAD = aminolevulinic acid dehydrogenase
ALA = aminolevulinic acid
FEP = free erythrocyte protoporphyrin



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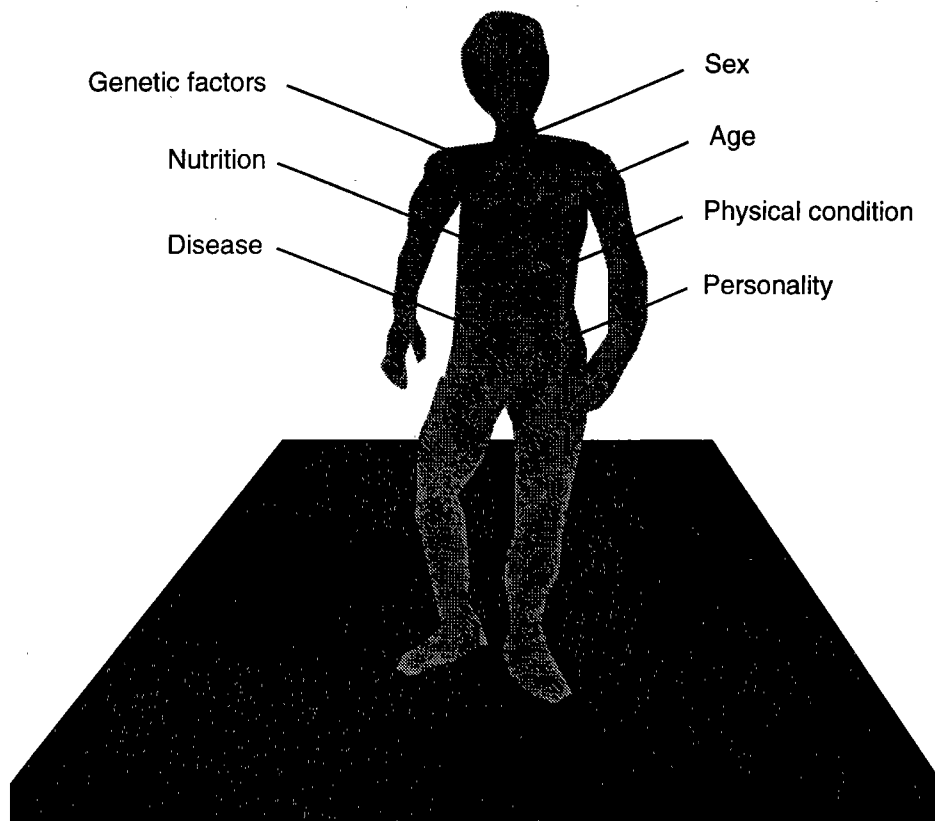
Source: WHO, 1977.

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The blood lead level at which specific effects on blood cell metabolism occur in a set proportion of an exposed population is higher for adult men than for women and children. Sex and age therefore influence the individual's reaction to lead exposure.

Figure 9.2

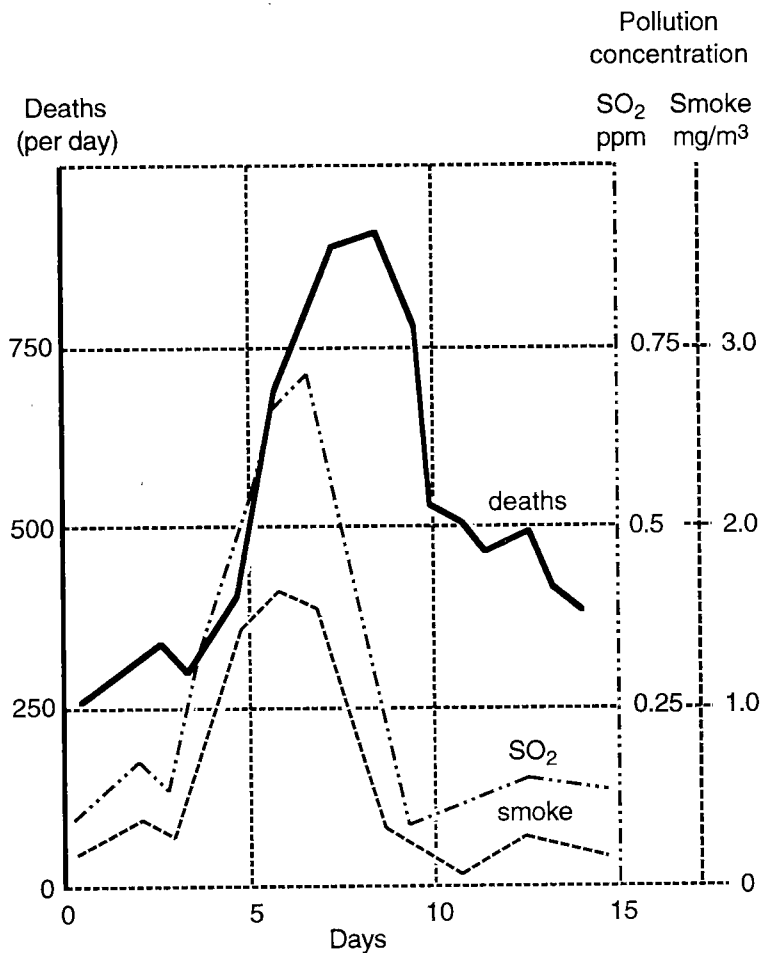
Individual characteristics that modify the effect of environmental factors



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The impact on an individual of a specific environmental factor depends on a variety of individual characteristics. These combine to create the basis for the variation in vulnerability to health effect as expressed by dose-response relationships and other frequency distributions of disease indicators.

Figure 9.3
The London smog epidemic, December 1952



WHO 92504



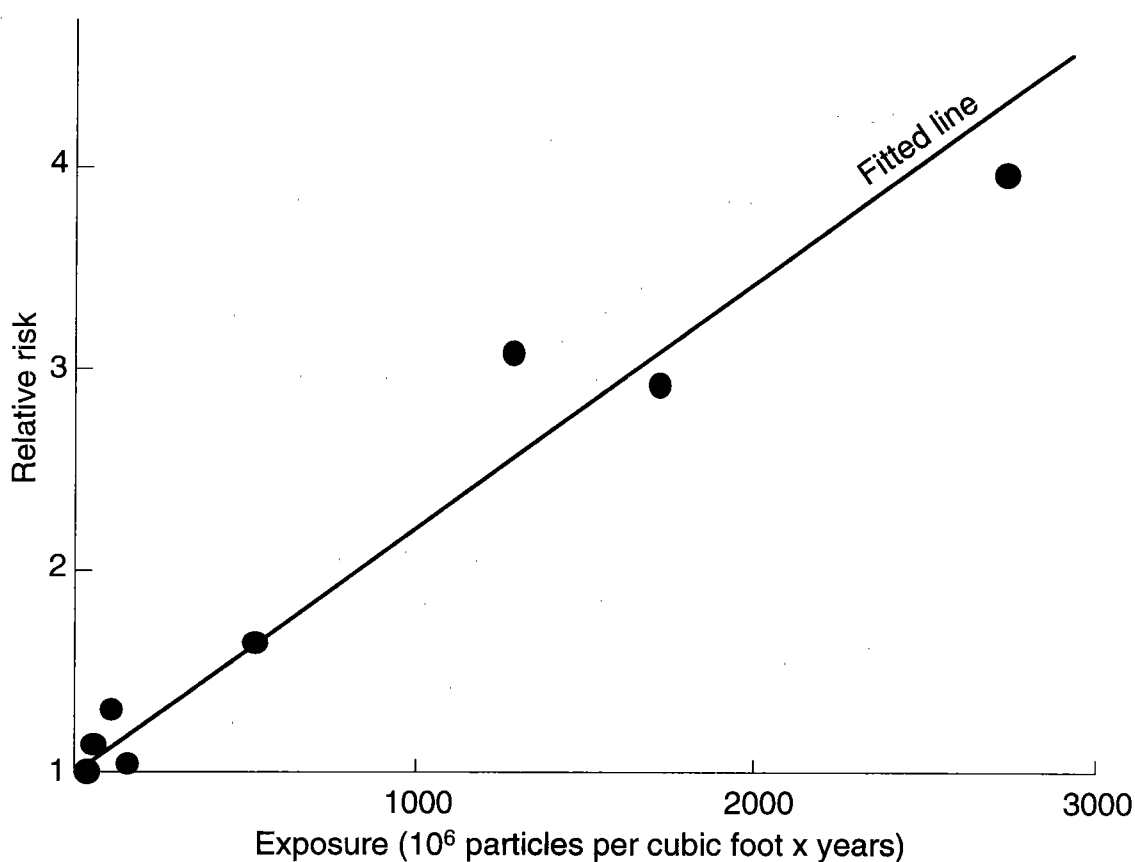
WORLD HEALTH ORGANIZATION

Source: United Kingdom Ministry of Health, 1954.

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An example of an acute effect (death due to heart and lung disease) of severe air pollution, levels of which rose just one day before the epidemic of smog-related disease started in London in 1952. When air pollution levels fell as a result of changes in the weather, the epidemic receded. In this case, air pollution levels are a relatively good indicator of external dose. Note that in several large cities in developing countries such as China and India, air pollution levels in the 1990s have on occasion been as high as they were in London in 1952.

Figure 9.4
Relationship between asbestos exposure (particle-years)
and relative risk of lung cancer



WHO 92505



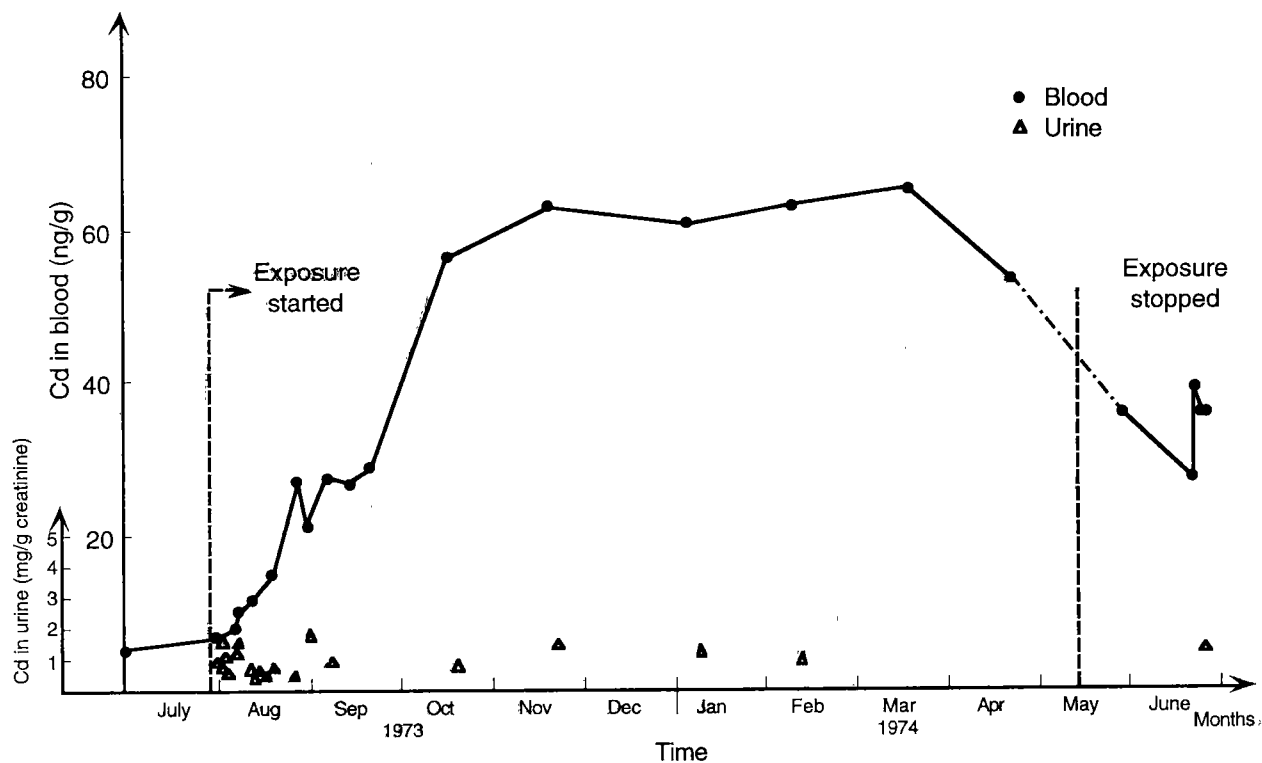
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Source: McDonald et al., 1980.

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Dose is here expressed as fibre level in air time (i.e. the exposure duration) in an asbestos workplace. Figure from a study in Canada showing a clear dose-response relationship.

Figure 9.5
Blood and urine levels of cadmium during the first year of occupational exposure



WHO 92506



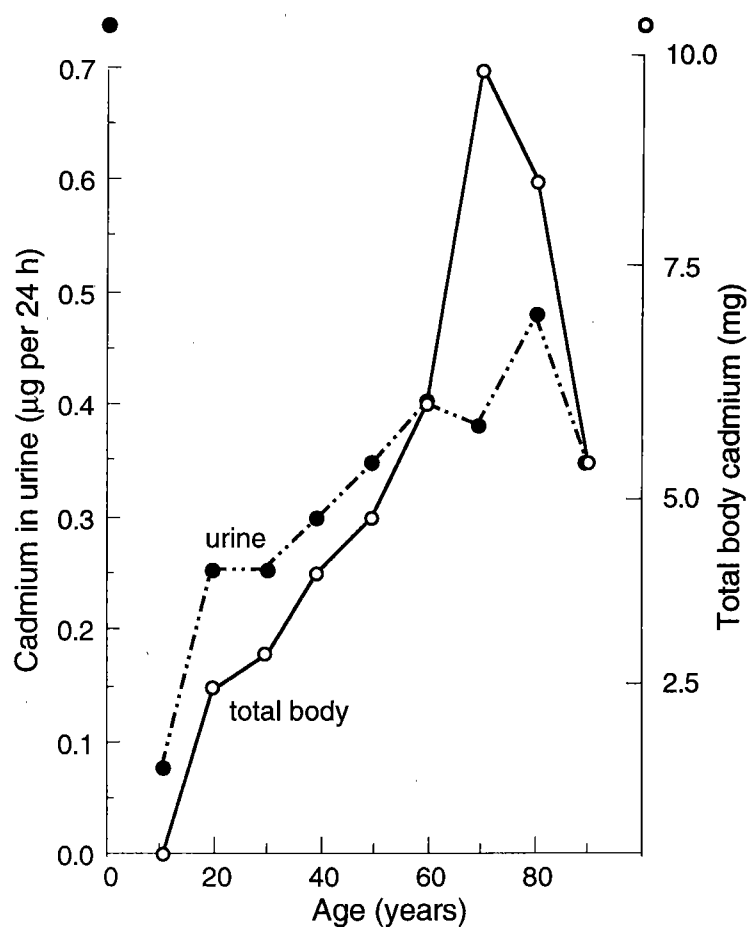
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Source: Kjellström & Nordberg, 1978.

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Biological monitoring can be a very useful means of measuring exposure level or dose. In this case the blood cadmium level is a good indicator of daily exposure level after the first three months of accumulation of cadmium in blood cells. Urine levels do not change perceptibly in the first year of exposure. Urine levels will increase later as the cadmium slowly accumulates in the kidney and other organs. Urine cadmium is therefore a better indicator of the accumulated internal dose.

Fig. 9.6
Relationship between cadmium dose
and urine cadmium



WHO 92507



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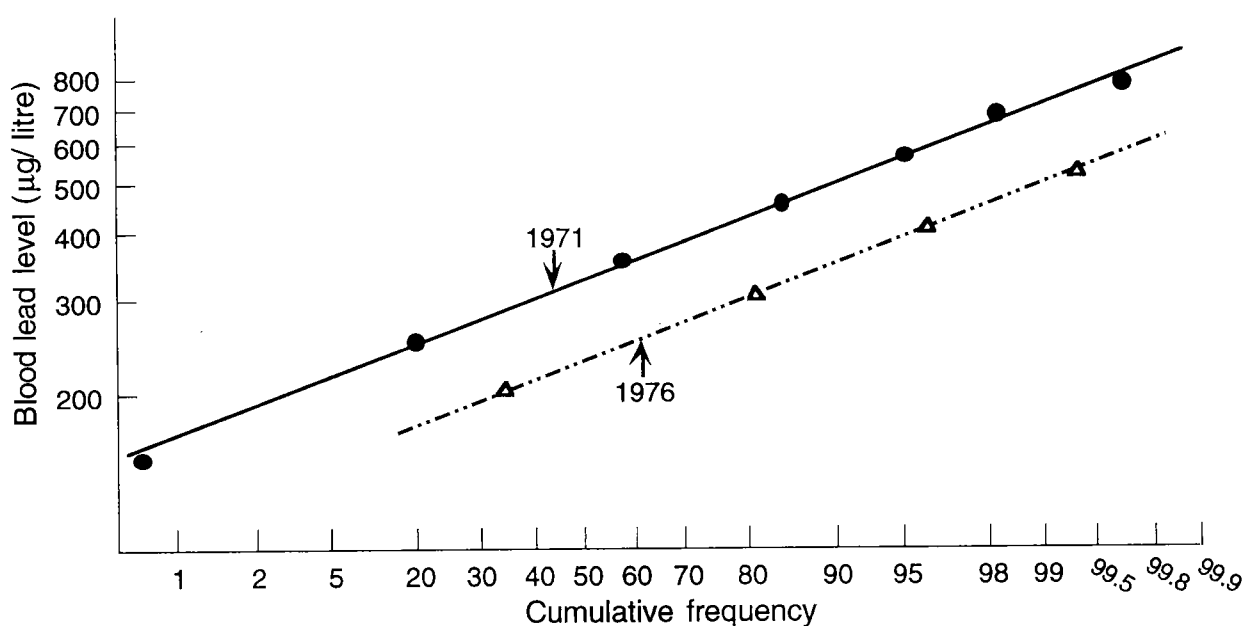
Source: Kjellström, 1977.

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The total body dose of cadmium was calculated from autopsy data in Sweden. These data, the basis of which is age-specific, are here compared with average urine cadmium excretions (per 24 hours) for "typical" Swedes of various age groups. There is a close association between the total body dose (or body burden) and the urine excretion.

Figure 9.7

**Cumulative distribution of blood lead in black children
in New York City, 1971 and 1976**



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Source: Billick et al., 1979. Reproduced by kind permission of the publisher.

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Group data on blood lead expressed as cumulative distributions with a "normal distribution scale" on the x-axis and a log-scale on the y-axis. The straight lines for the distributions indicate that the frequency distributions are log-normal. The lead doses as measured by blood lead are higher for 1971 than for 1976, with the mean (50-percentile) ranging from about 300 µg/l down to about 200 µg/l. Percentiles of children above specific blood lead values can be assessed easily.

Table 9.2

**Full-scale and subtest scores on the Wechsler
Intelligence Scale for Children (Revised) (WISC-R) for
subjects with high and low lead levels in teeth**

WISC-R	Low lead (< 10 mg/kg) (mean)	High lead (> 20 mg/kg) (mean)	P value (one-sided)
Full-scale IQ	106.6	102.1	0.03
Verbal IQ	103.9	99.3	0.03
Information	10.5	9.4	0.04
Vocabulary	11.0	10.0	0.05
Digit span	10.6	9.3	0.02
Arithmetic	10.4	10.1	0.49
Comprehension	11.0	10.2	0.08
Similarities	10.8	10.3	0.36
Performance IQ	108.7	104.9	0.08
Picture completion	12.2	11.3	0.03
Picture arrangement	11.3	10.8	0.38
Block design	11.0	10.3	0.15
Object assembly	10.9	10.6	0.54
Coding	11.0	10.9	0.90
Mazes	10.6	10.1	0.37

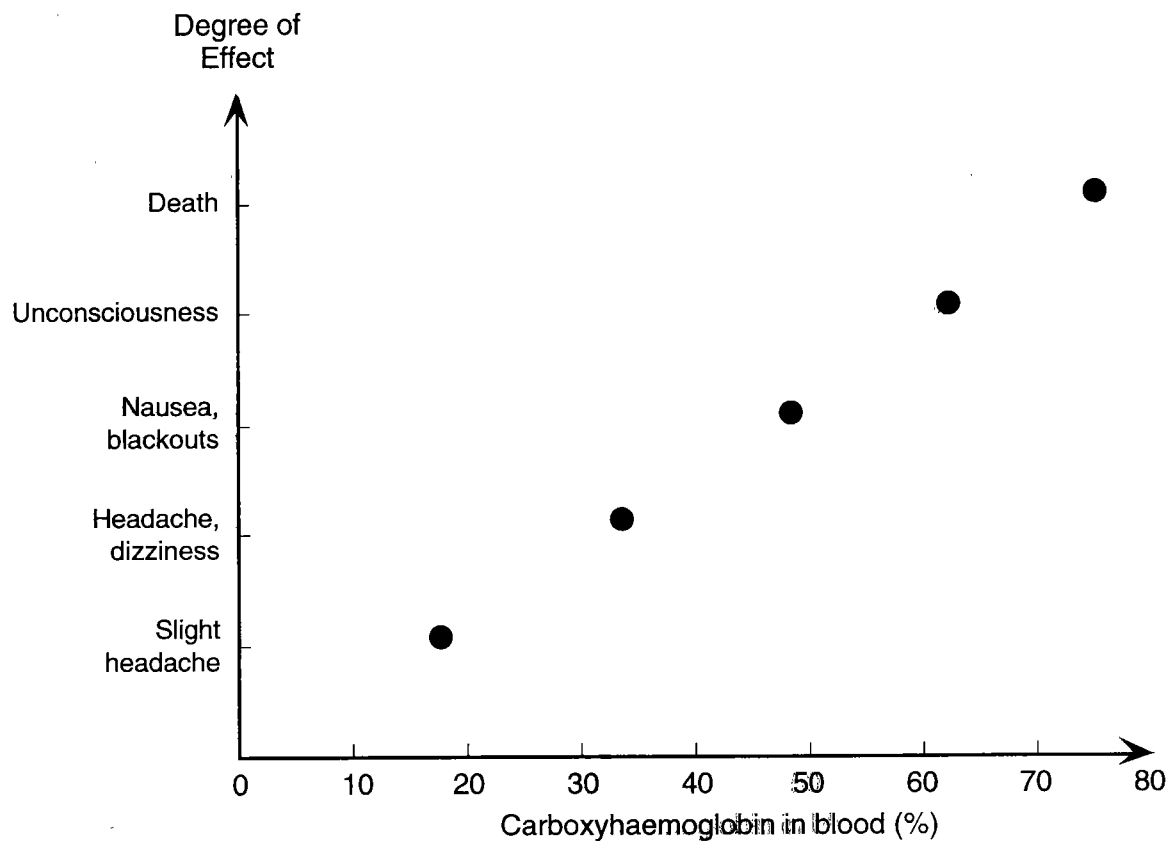
**WORLD HEALTH ORGANIZATION**

Source: Needleman et al., 1979. Reproduced by kind permission of the publisher.

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There is little variation here between the psychological test scores for groups with low blood lead and those for groups with high blood lead. Yet the differences are statistically significant since even small shifts in the mean of a normal distribution, such as the distribution of WISC-R scores, can produce large changes in the percentile above or below a certain value. The public health impact of the findings shown in this table may therefore be much greater than the visual impact of these data suggests.

Figure 9.8
Dose–effect relationship



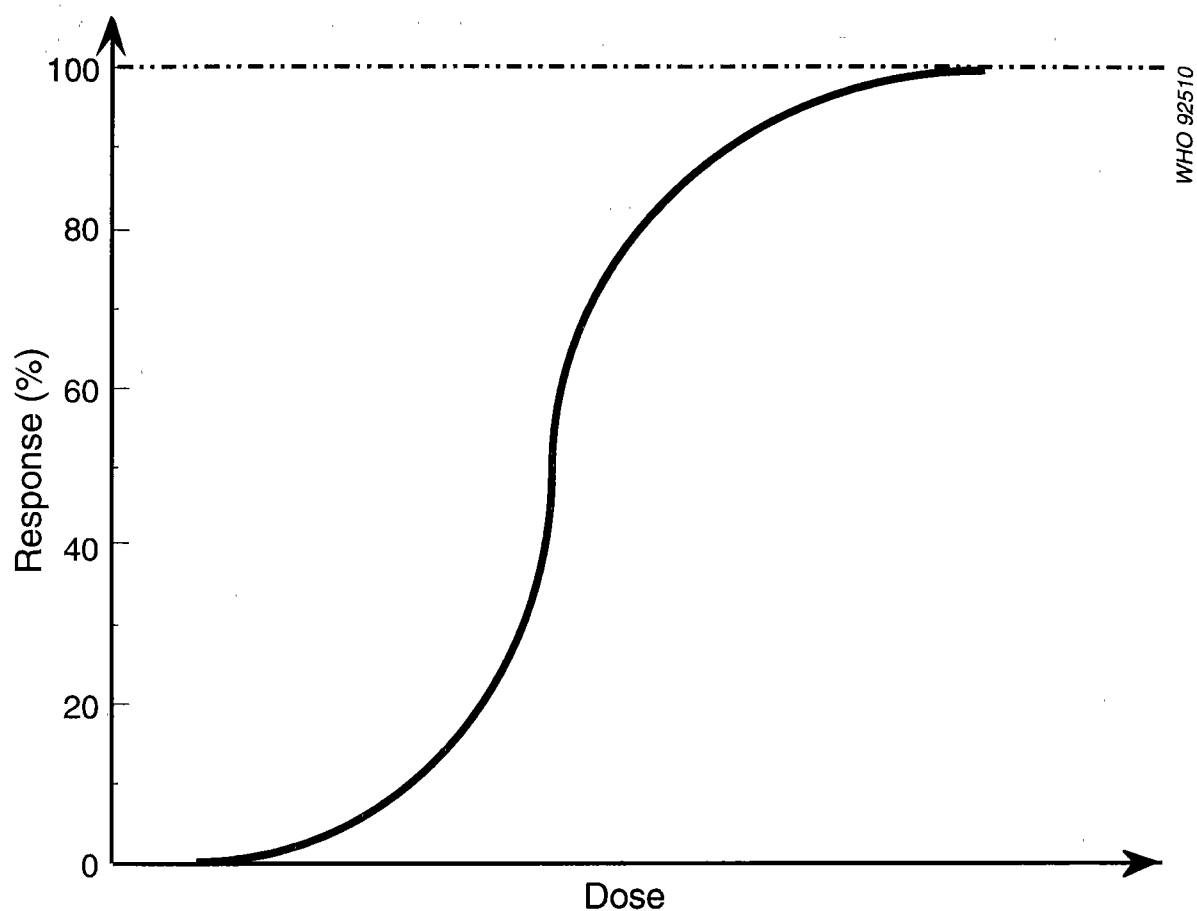
WHO 92509



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In a dose–effect relationship the severity of the effect increases as the dose increases. Here carboxyhaemoglobin ranges from below 20 to above 70 percent. At the lowest level an exposed person would typically develop a slight headache and at the highest level the person would be dead.

Figure 9.9
Dose-response relationship

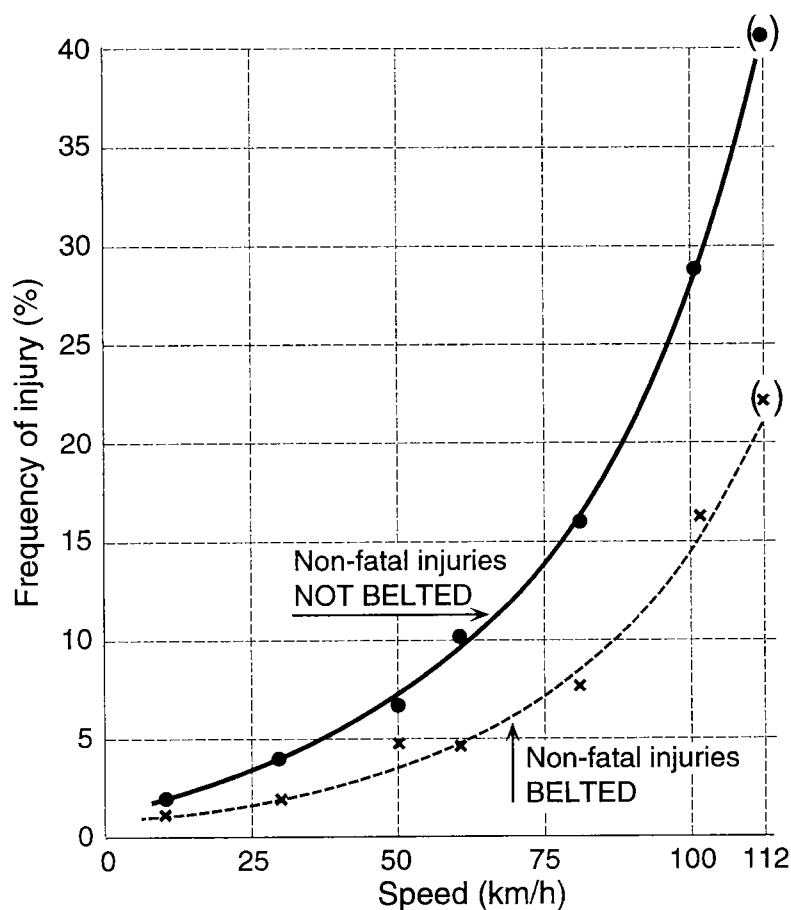


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In a dose-response relationship the dose on the x-axis is compared with the occurrence rate of a specific effect at that dose level (the response). Typically the relationship will take the S-shape of a cumulative normal distribution if the whole range of response from 0 to 100 percent is included. In truncated relationships, where only a very small part of this range is included, the relationship may look like a straight line. Examples of dose-response relationships were given earlier (Figure 1.1, Table 5.2, Figure 9.4).

Figure 9.10

Relationship between driving speed, seat-belt use, and frequency of injury in motor car drivers involved in collisions



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Source: Bohlin, 1967. Reproduced by kind permission of the publisher.

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The concept of dose-response relationship also applies to injuries whenever the "dose" can be quantified. In this case, speed is used as an indicator of dose. It is clear that the risk of non-fatal injury in a collision increases in a dose-response fashion the higher the speed at time of collision. Using seat-belts reduces the risk of injury by about 50 percent.

7.10 Chapter 10 resources

Learning objectives overhead

Overhead explanations

Overhead 10.1	Health services planning
Overhead 10.2	Evaluation
Overhead 10.3	The health care planning process
Overhead 10.4	Efficacy, effectiveness, and efficiency
Overhead 10.5	Implementation
Overhead 10.6	Health monitoring
Overhead 10.7	Healthy public policy
Overhead 10.8	Health promotion

Overhead tables and figures from *Basic Epidemiology*

Figure 10.1	The health care planning cycle
Table 10.1	Percentage of adult population (18–74 years) with undiagnosed hypertension, by race and time, in the USA
Table 10.2	Variation in length of hospital stay for patients with uncomplicated myocardial infarction
Table 10.3	Estimated cost of each extra quality-adjusted life year (QALY) gained as a result of selected procedures
Table 10.4	Health care planning: the case of hypertension
Figure 10.2	Healthy public policy
Table 10.5	Development of healthy public policy with respect to coronary heart disease, USA

Learning Objectives: Chapter 10

- 1. Demonstrate how epidemiological principles and methods can be used for the planning and evaluation of health services.**
- 2. Describe how the results of epidemiological research can be used to influence public health policy.**
- 3. Outline the principles of the Ottawa Charter for health promotion.**



Overhead 10.1

HEALTH SERVICES PLANNING

**The process of identifying key
objectives and choosing
between alternative means
of achieving
those objectives.**



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EVALUATION

**The process of determining
the relevance,
effectiveness,
efficiency,
and impact
of activities.**



THE HEALTH CARE PLANNING PROCESS

Health care interventions:

- 1. burden of illness**
- 2. causation**
- 3. community effectiveness**
- 4. efficiency**
- 5. implementation**
- 6. reassessment and
monitoring**



EFFICACY, EFFECTIVENESS, AND EFFICIENCY

EFFICACY:

How well does the intervention work under ideal conditions?

EFFECTIVENESS:

How well does the intervention work when it is applied in the community?

EFFICIENCY:

Are the results achieved in keeping with the effort spent (in time, money, resources?)



IMPLEMENTATION

Implementation requires targets that are:

- **specific**
- **quantified**
- **timed.**



HEALTH MONITORING

**Health monitoring
measures changes in the
health status of the
population or within
the environment.**



Overhead 10.7

HEALTHY PUBLIC POLICY

**Healthy public policy is a
concern for health and equity
in all areas of policy.**

**The goal of healthy public
policy is to promote health.**



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HEALTH PROMOTION

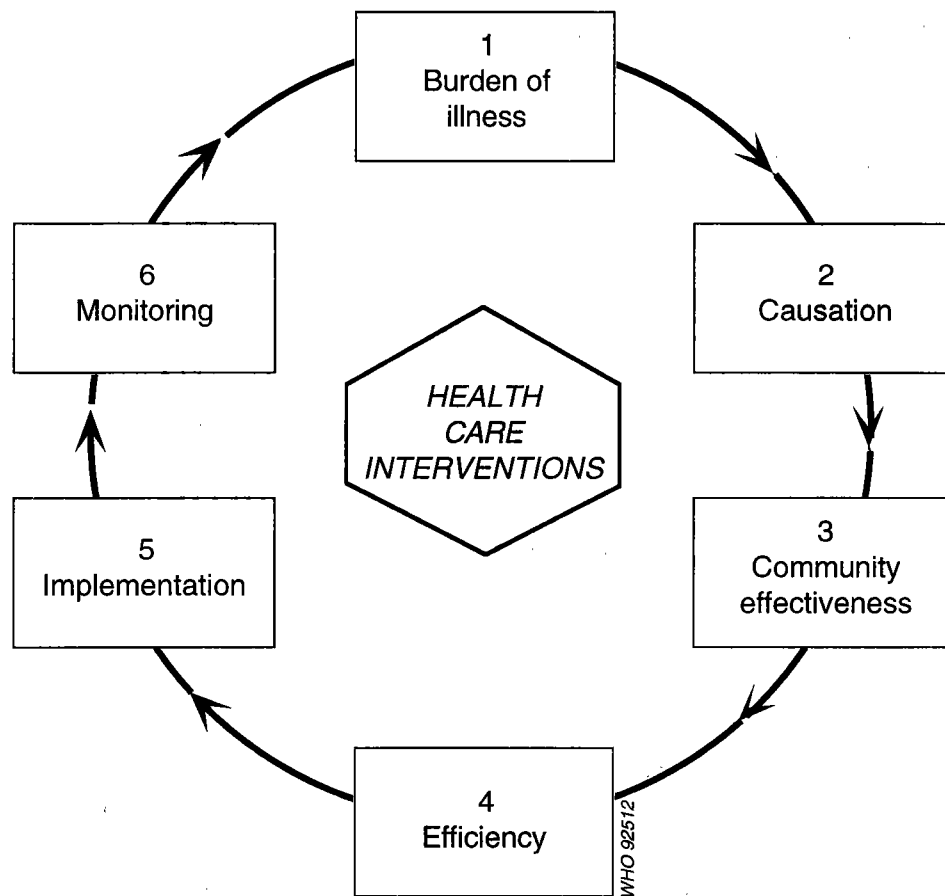
The process of enabling people to increase control over and to improve their health ...

It means:

- **creating supportive environments**
- **strengthening community action**
- **developing personal skills**
- **reorienting health services**
- **developing health advocacy.**



Figure 10.1
The health care planning cycle



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Source: Tugwell et al., 1985. Reproduced by kind permission of the publisher.

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The health care intervention planning cycle involves six stages at each of which epidemiological data or studies will be essential. Use an example from your country to show the specific activities involved at each step.

Table 10.1

**Percentage of adult population
(18–74 years) with undiagnosed
hypertension, by race and time,
in the USA**

Race	1971–74	1976–80
White	11.2	7.6
Black	17.1	6.9



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Source: Drizd et al., 1986.

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The burden of illness as measured by the prevalence of undiagnosed hypertension in the USA. Hypertension screening and treatment programmes have over time reduced this burden of illness.

Table 10.2

**Variation in length of hospital
stay for patients with uncomplicated
acute myocardial infarction**

Time	Length of stay
1950s	4–8 weeks
1960s	3 weeks
1970	2 weeks
1980	7–10 days
1988	4–5 days



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Source: Curfman, 1988.

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Measuring the effectiveness of specific interventions in terms of the average length of hospital stay for a myocardial infarction, for different decades. Improved treatment during the hospital stay and improved management of the disease afterwards have made it possible to reduce the length of hospital stay considerably.

Table 10.3

**Estimated cost of each extra
quality-adjusted life year (QALY) gained
as a result of selected procedures**

Procedure	Cost per QALY gained (pounds sterling)
Aortic valve replacement	900
Pacemaker	700
Heart transplant	5 000
Kidney transplant	3 000
Hospital haemodialysis	14 000
Home haemodialysis	11 000
Hip replacement	750



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Source: Williams, 1985. Reproduced by kind permission of the publisher.

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In order to set priorities for medical care interventions, the cost of a "life saved" can be compared for different interventions. For this table "lives saved" were quantified according to the health quality of that life (whether the persons could be cured or remained disabled, etc.). Pacemakers and hip replacements appear to be the most cost-efficient.

Table 10.4

Health care planning: the case of hypertension

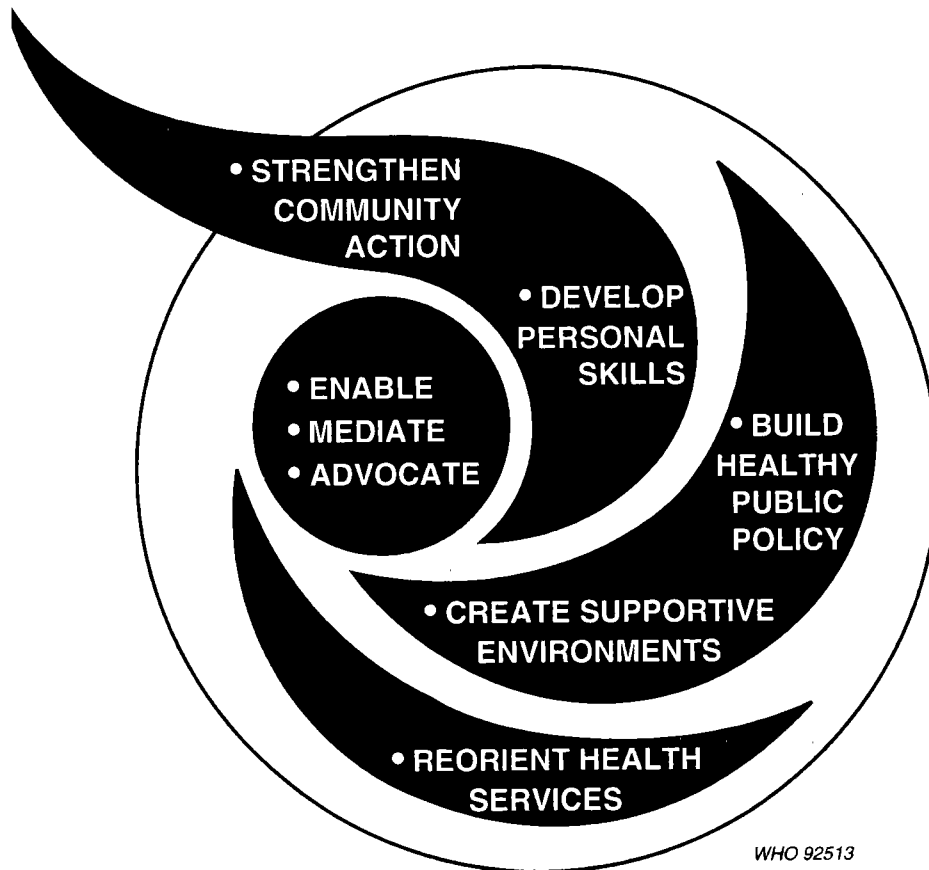
Burden	Population surveys of blood pressure and control of hypertension
Etiology	Ecological studies (salt and blood pressure) Observational studies (weight and blood pressure) Experimental studies (weight reduction)
Community effectiveness	Randomized controlled trials Evaluation of screening programmes Studies of compliance
Efficiency	Cost-effectiveness studies
Implementation	National control programmes for high blood pressure
Monitoring	Assessment of personnel and equipment Effect on quality of life
Reassessment	Remeasurement of population blood pressure levels



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Example of the steps that can be taken for the prevention and management of hypertension in the community.

Figure 10.2
Healthy public policy



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Source: Ottawa Charter for Health Promotion, 1986.

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Graph showing the different components of a healthy public policy that promotes positive health.

Table 10.5

**Development of healthy public policy
with respect to coronary heart disease, USA**

Time	Event
1940–1950s	Community burden of coronary heart disease recognized
1950–1960s	Epidemiological evidence accumulates on the importance of major risk factors
1960–1980s	Experimental studies of increasing sophistication are conducted
1960s onwards	Official statements (for example, the American Heart Association) on the significance of risk factors and the importance of prevention
1972 onwards	National High Blood Pressure Education Programme
1985	National Consensus Development Conference on Lipids and Coronary Heart Disease
1986	National High Blood Cholesterol Programme



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Source: Syme & Guralnik, 1987.

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Example of steps taken in healthy public policy development in order to help prevent coronary heart disease. Additional steps, such as legislation and health promotion to encourage reduction of tobacco smoking, have also been taken.

7.11 Chapter 11 resources

Three overheads summarize the key criteria for the critical assessment of journal articles: Further material (prepared by the Department of Clinical Epidemiology and Biostatistics of the McMaster University Health Sciences Centre) can be found in Volume 124 of the *Canadian Medical Association Journal*.

Learning objectives overhead

Overhead explanations

Overhead 11.1	Criteria for the critical assessment of a paper on the diagnosis of disease
Overhead 11.2	Criteria for the critical assessment of a paper on benefits of therapy
Overhead 11.3	Criteria for the critical assessment of a paper on diagnostic tests

Overhead table from *Basic Epidemiology*

Table 11.1	Basic epidemiological information about a disease
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Handouts and teacher's notes

Handout 11.1	Diagnostic test
Handout 11.2	Critical appraisal exercise
Teacher's notes 11.2	Suggested answers to critical appraisal exercise

Learning Objectives: Chapter 11

- 1. Demonstrate different ways of applying and developing epidemiological knowledge and skills.**
- 2. Understand how to read medical and health literature critically.**
- 3. Outline the steps in study design and in preparing a research protocol.**



Overhead 11.1

**CRITERIA FOR THE CRITICAL
ASSESSMENT OF A PAPER ON THE
DIAGNOSIS OF DISEASE:**

- 1. Was a cohort assembled?**
- 2. Was the referral pattern described?**
- 3. Was complete follow-up achieved?**
- 4. Were objective outcome criteria developed and used?**
- 5. Was the outcomes assessment done "blind"?**
- 6. Was adjustment for other unrelated prognostic factors carried out?**



Overhead 11.2

**CRITERIA FOR THE CRITICAL
ASSESSMENT OF A PAPER ON
THE BENEFITS OF THERAPY:**

- 1. Was the assignment of patients to treatments really randomized?**
- 2. Were all clinically relevant outcomes reported?**
- 3. Were the study patients recognizably similar to your own?**
- 4. Were both clinical and statistical significance considered?**
- 5. Is the therapeutic measure feasible in your setting?**
- 6. Were all patients who entered the study accounted for at the end?**



Overhead 11.3

**CRITERIA FOR THE CRITICAL
ASSESSMENT OF A PAPER ON
DIAGNOSTIC TESTS:**

- 1. Was there an independent ("blind") comparison with an agreed standard of diagnosis?**
- 2. Did the patient sample include an appropriate spectrum of mild and severe, treated and untreated disease?**
- 3. Was the setting for the study (and the referral pathway) described adequately?**
- 4. Was the reproducibility of the test result (precision) and its interpretation (observer variation) determined?**
- 5. Was the term "normal" defined?**



Table 11.1

Basic epidemiological information about a disease

Natural history in the individual:

- development with age
(cohort basis)
- early indicators
(for screening)
- impact of different treatments
- possibility of cure
- needs for care
- social impact

Etiology:

- specific casual factors
- other risk factors

Development in the community:

- time trends
- variations with age
(cross-sectional basis)

Differences in occurrence:

- sex
- ethnic group
- social class
- occupation
- geographical area

Possibilities for prevention:

- specific actions against
causal factors
- general actions against
other risk factors
- impact of medical services
- impact of health policy



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Summary of issues to be analysed when collecting basic epidemiological information about a disease. This information can then be used to establish priorities for different types of prevention (primordial, primary, secondary or tertiary) and to plan the health service in relation to this disease.

Handout 11.1

DIAGNOSTIC TEST

Aim

To determine and demonstrate whether a given diagnostic test is likely to be both accurate and useful.

Questions

1. What is the prevalence of [the condition]?
2. If the patient has a positive test, what is the likelihood that the patient really has [the condition]?
3. If the test is negative, what is the likelihood that the patient really does not have [the condition]?
4. If the patient really has [the condition], what is the likelihood that the test would be positive? (SENSITIVITY).
5. If the patient really does not have [the condition], what is the likelihood that the test would be negative? (SPECIFICITY)
6. If the test was applied to a group of people in which the prevalence of [the condition] was higher (or lower), what would be the effect on the answers for questions 2–5?

Handout 11.2

CRITICAL APPRAISAL EXERCISE

Read the following abstract and answer the questions.

Abstract

Fifty-two patients, who were not considered to be suitable for traditional therapy, were evaluated on their admission (53 admissions) to the Slow Stream Rehabilitation Unit at Greenwich Hospital, and on and after their discharge from hospital, with a minimum follow-up period of 13 months after discharge. Mobility and the capacity to perform basic self-care activities were assessed by means of a set protocol while traditional rehabilitation therapies were employed. Of the 53 admissions to hospital, there were eight inpatient deaths and 45 discharges from the Unit (19 discharges to home and 26 discharges to institutional care). This represents a considerable improvement over the initial assessment that all patients would need nursing home accommodation or prolonged hospitalization. By the time of the second follow-up examination, seven of the 19 patients who had been discharged home originally, still resided at home. There were 15 patients in nursing care while 23 patients had died. Most patients had maintained their discharge levels of mobility and self-care, unless a further disability had supervened. The majority of carers and patients expressed gratitude for the opportunity given to patients to undergo therapy, with the possibility of an eventual return to their own homes, rather than having had to proceed directly to a nursing home.

Reference: O'Neil T.J., McCarthy K., Newton B.M. Slow stream rehabilitation—is it effective? Medical Journal of Australia, 1987, 147:172–175.

Questions

1. What answer does the abstract give to the question in the title of the journal article?
2. What was the aim of the study?
3. Was this a randomized control trial?

PAGE 2 OF HANDOUT 11.2

4. How might a randomized trial have been set up given the information provided in the subject's section?
5. What is the major bias concerning the choice of patients in this study?
6. What information about functional independence is provided? How valid is this measurement?
7. In the interpretation of results, what comparisons are being made?
8. Are the comparisons made between the two groups comparing like with like?

Teacher's notes 11.2

SUGGESTED ANSWERS TO CRITICAL APPRAISAL EXERCISE

1. The title of this article clearly indicates that it sets out to determine the benefits of a particular form of therapy. The abstract leaves the reader with a strong impression that slow stream rehabilitation is effective.
2. The aim of the study is clearly indicated in the introduction: to evaluate the effectiveness of the first two years of slow stream rehabilitation as part of an evaluation of the benefits of a slow stream rehabilitation unit.
3. No. Since it is clear even from the abstract that no mention has been made of the randomization of patients, this immediately highlights one of the problems of the study.
4. By choosing as potential subjects those who were not considered to be suitable for traditional therapy (as was done) and then dividing that group of patients randomly into slow stream treatment and non-slow stream treatment groups.
5. If only patients believed to be able to benefit from rehabilitation were chosen, then results will be biased towards showing that rehabilitation is effective.
6. It is hard to judge if there is any clinical significance. Also, clinical outcomes are not mentioned.
7. The judgement of the effectiveness of therapy provided at home with slow stream rehabilitation and those without, compared to those not at home.

8. Cost of rehabilitation (which involves a large number of personnel) is being compared with traditional nursing home care. In any cost consideration all costs must be included. This study does not evaluate the full costs of rehabilitation.

THE GLOBAL ENVIRONMENTAL EPIDEMIOLOGY NETWORK

G E E N E T



GEENET

The Network was established by the World Health Organization in 1987 as a means of strengthening education, training and applied research in health effects assessment and environmental epidemiology.

The Network's focus is the collaborative activities among members. These are supported by the Office of Global and Integrated Environmental Health at WHO headquarters, the environmental health staff in the six WHO Regional Offices, and associated technical centres.

To support member activities, the Network produces various documents concerning the development and promotion of environmental epidemiology research and training. These, together with lists of Network members, are distributed regularly and will be made available electronically via Internet. GEENET also organizes training and research workshops in collaboration with national and international agencies.

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